

JPRS-CST-87-019

6 MAY 1987

China Report

SCIENCE AND TECHNOLOGY

SPECIAL NOTICE INSIDE

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Effective 1 June 1987 JPRS reports will have a new cover design and color, and some reports will have a different title and format. Some of the color changes may be implemented earlier if existing supplies of stock are depleted.

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SOVIET UNION.....	salmon
EAST ASIA.....	yellow
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LATIN AMERICA.....	pink
WEST EUROPE.....	ivory
AFRICA (SUB-SAHARA).....	tan
SCIENCE & TECHNOLOGY.....	gray
WORLDWIDES.....	pewter

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- USSR: EARTH SCIENCES (UES)
- USSR: MATERIALS SCIENCE (UMS)
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- USSR: SPACE BIOLOGY & AEROSPACE MEDICINE (USB)
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CHINA REPORT SCIENCE AND TECHNOLOGY


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NATIONAL DEVELOPMENTS

U.S. COMPUTER FIRM OPENS PLANT IN CHINA

Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 19, 8 Oct 86 p 1

[Text] In response to an invitation by our Ministry of Electronics, Dr Wang An, president of the U.S. Wang Computer Company and well known Chinese-American scientist and entrepreneur, will arrive in China for a visit in early October, when he will personally preside over opening ceremonies for the "Shanghai Wang An Computer Development Company," jointly funded and run by Wang Computers, China, Ltd. and the Shanghai Computer Development Company.

The Shanghai Wang An Computer Development Company is an advanced science and technology enterprise. With the support of the U.S. Wang Computer Company, this company will continuously import high science and technology, use the newest automated production techniques, will begin by manufacturing Wang small-scale machines, then in accordance with the needs of the Chinese national situation will gradually develop to the point of manufacturing the Wang series of products.

For the staff of this company, with the exception of the board of directors and high level administrative personnel the selection of whom will be the joint appointment of both investors, employment will be solicited openly. Currently, equipment for the first period has arrived in Shanghai and is being installed. The entire body of staff and personnel are undergoing intense training. It is planned that formal initiation of production will begin 11 October.

Production, testing, maintenance, and the technology utilized by all products of the Shanghai Wang An Company will be provided by the U.S. Wang Company. The Wang Company will also send over engineers who are specialists in testing and verification who will strictly check all items before acceptance to ensure that in the areas of quality, techniques, and reliability, manufactured products have attained the uniform standards for the Wang Company throughout the world. In addition, the Wang Company will develop applications software for domestic users through this jointly funded enterprise, and will develop training and maintenance services.

It is said that Dr. Wang is preparing to construct and fund a similar enterprise in Taiwan, and that what has already been built and in production in 1982 has done a net volume of operations to date of \$130 million to become one of the most profitable foreign enterprise for Wang computers.

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CSO: 4008/1015

NATIONAL DEVELOPMENTS

DETAILED REGULATIONS ON PROFESSIONAL TECHNICAL POSTS

Beijing KEJI QINGBAO GONGZUO [SCIENTIFIC AND TECHNICAL INFORMATION WORK] in Chinese No 1, Jan 87 pp 1-7

[Text] Editor's note: In the spirit of the "Circular of the CPC Central Committee and the State Council on Transmitting the 'Report Concerning the Reform of Title Evaluation and the Implementation of a Professional Technical Appointment System,'" and relevant documents put out by the central leading group on title reform, the State Science and Technology Commission has designated the China Scientific and Technical Information Research Institute as an experimental unit and instructed the institute to draw up the "Detailed Regulations of the China Scientific and Technical Information Research Institute for Implementing Trial Regulations Concerning Professional Technical Posts." The "detailed regulations" were submitted by the State Science and Technology Commission to the central leading group on title reform for examination and approval. On 17 October 1986 the central leading group approved the transmission of the "detailed regulations" to all provincial, autonomous regional, and municipal people's governments, all central ministries and commissions, all general political departments, and all mass organizations so that it would be available to all information research institutes for their reference. The "detailed regulations" are reprinted here in full.

The detailed regulations are formulated to fully unleash the initiative and creativity of scientific and technical information personnel, establish a position responsibility system for scientific and technical information work, and promote the sound circulation of qualified personnel. They are formulated in the spirit of CPC Central Committee documents on the implementation of an appointment system for professional technical posts and in the light of the actual circumstances of the institute.

I. Categories of Professional Technical Posts

This institute is a comprehensive scientific and technical information research unit. Its work is diversified and the specialties of its technical cadres range far and wide. Based on the classification of technical positions approved by the state, we have essentially selected five categories of professional technical posts. Below are the categories and their job titles at different levels:

Category	Title				
	Senior Posts	Mid-level Posts		Junior Posts	
Scientific research	Research fellow	Associate Research Fellow	Assistant Researcher	Research Trainee	
Engineering Technology	Senior Engineer	Senior Engineer	Engineer	Assistant Engineer	Technician
Books and Materials	Librarian	Associate Librarian	Library Assistant	Library Aide	Clerk
Translation	Translator Editor	Associate Translator Editor	Translator	Assistant Translator	
Publishing and editing	Copy Editor	Associate Copy Editor	Editor	Assistant Editor	

II. The Appropriate Scope of the Various Categories of Professional Technical Posts at the Institute

The classification of professional technical posts is based on the nature of the work.

A. Scientific Research Category. This includes scientific and technical information personnel in scientific and technical information research, in research on the theory and methodology of information, and in research on the modernization of the tools of information.

B. Engineering Technology Category. This includes scientific and technical information personnel engaged in the development and management of computer systems, the management and circulation of scientific and technical achievements, and the management of scientific and technical information, as well as technical personnel that handle audio-visual equipment, copying, and printing.

C. Books and materials category. This includes scientific and technical information personnel engaged in collecting, processing, servicing, and managing scientific and technical documents.

D. Translation category. This includes scientific and technical information personnel engaged in the translation of foreign materials and other personnel whose primary responsibility is translation.

E. Publishing and editing category. This includes scientific and technical information personnel engaged in the editing of formal publications such as books, journals, and other materials on scientific and technical information.

Apart from the major categories of professional technical posts mentioned above, medical, financial, and other professional technical posts have also been created under relevant government regulations.

III. Proportion and Establishment Level of the Various Categories of Professional Technical Posts (Set Forth Separately)

IV. Qualifications for Appointment to Professional Technical Posts

Holders of professional technical posts must possess the following basic qualifications:

A. Deeply love the motherland, obey the constitution and the law, and actively contribute their own strength to China's four modernizations;

B. Possess the practical competence, professional expertise, and professional ethics necessary to the execution of the responsibilities involved;

C. Holders of senior, mid-level, and junior professional technical posts shall generally possess college, polytechnic, and technical secondary school qualifications, respectively. Professional technical personnel who do not possess the qualifications stipulated above but who have solid expertise, perform well, have made outstanding contributions, and otherwise meet the requirements for appointment shall also be appointed to professional technical posts as need be.

D. Be physically fit and able to perform normal work regularly.

A. Qualifications for appointment to scientific research posts

1. Research trainee. Master's degree; or bachelor's degree or graduation from college, with 1 year of practical training; or graduation from a polytechnic, with over 3 years of experience in research work, plus the following qualifications:

a. basic elementary knowledge of the specialty concerned and professional knowledge;

b. familiarity with the basic steps of scientific and technical information research work, a preliminary understanding of research methods and techniques, and an ability to carry out actual research under the direction of senior and mid-level research personnel; and

c. ability to read scientific and technical materials in one foreign language.

2. Assistant researcher. Four years of experience as a research trainee or a doctor's degree; or master's degree and 2 years of research experience, plus the following qualifications:

a. good performance at work resulting in scientific achievements of scientific significance or practical value;

b. a solid grasp of the fundamentals of the specialty concerned and of professional knowledge, a basic understanding of the standards and emerging trends in the specialty in question at home and abroad, and an ability to conduct research on scientific and technical information independently;

c. ability to guide junior research personnel in their work and study; and

d. ability to read and translate relevant scientific and technical materials in a foreign language proficiently.

3. Associate research fellow. Five years of experience as assistant researcher or more than 3 years of post-doctoral experience in research work, plus the following qualifications:

a. a systematic and solid grasp of the fundamentals of the specialty concerned or extensive scientific technical knowledge. Ability to use this knowledge to solve the more complex theoretical or technical problems in scientific and technical information research work. Ability to conduct research creatively.

b. ability to keep abreast of where the specialty is heading for at home and abroad. Ability to identify the research direction in the research area concerned, select research topics, put forward effective research approaches, and formulate feasible research plans. Knowledge of two foreign languages.

c. Significant accomplishments at work, including scientific research achievements of substantial practical value or social economic results, or scientific papers of considerable academic value.

d. ability to direct and organize group research; and

e. ability to train and guide the work and study of mid-level scientific and technical information research personnel and candidates for master's degrees.

4. Research fellow. Five years of experience as associate research fellow, plus the following qualifications:

a. major contributions to scientific and technical information research. Outstanding accomplishments at work, including scientific research achievements with significant social or economic results or the authorship of academic treatises or papers of an international standard. Ability to solve key issues in scientific and technical information research creatively;

b. a systematic, solid grasp of the basic knowledge of the specialty concerned and extensive scientific and technical knowledge. Ability to keep abreast of where the specialty is heading at home and abroad, pursue a research direction for the specialty, set research topics, or open up new information research territory. Ability to direct and organize major national information research projects;

c. a good command of two foreign languages. Ability to read and translate relevant scientific and technical materials proficiently; and

d. ability to train mid-level information research personnel and candidates for master's and doctor's degrees.

B. Qualifications for appointment to engineering technical posts:

1. Technician. Basic technical knowledge relevant to the post currently held by the individual concerned as well as knowledge of the methods of information work in a certain area. Ability to complete technical work of an auxiliary nature or perform general information tasks. Graduation from a polytechnic or technical secondary school, with one year of experience in a technical post. Satisfactory evaluation.

2. Assistant engineer. Basic professional technical knowledge relating to the post currently held by the individual concerned and knowledge of information work in a certain area. Ability to inspect, maintain, and repair information equipment (audio-visual equipment, microfilm equipment, copying machines, and computer equipment, etc.,) or process and handle certain kinds of information under the direction of senior and mid-level technical personnel. Plus any one of the following academic qualifications: master's degree or a second bachelor degree, in addition to satisfactory evaluation; or graduation from college, with 1 year of practical training; or graduation from a polytechnic, with over 3 years of experience in technical work; or graduation from technical secondary school, with over 5 years of experience in technical work.

3. Engineer. Solid grounding in basic professional knowledge. Familiarity with information work. A good command of a foreign language. Acquaintance with developments in the specialty concerned at home and abroad. Ability to handle major technical issues in his post independently or ability to handle related technical information research independently. Plus any one of the following academic qualifications: a doctor's degree and ability to discharge the responsibilities of an engineer satisfactorily; or a master's degree, or a second bachelor's degree, 3 years of experience as an assistant engineer, and satisfactory evaluation; or a bachelor's degree or graduation from college, with over 4 years of experience as assistant engineer and satisfactory evaluation.

4. Senior engineer. Mastery of the knowledge of the specialty concerned and systematic knowledge of information theories. Considerable experience in technical work. Proficiency in one foreign language. Familiarity with major issues and development trends related to his post at home and abroad. Ability to organize and lead major information engineering projects, including the analysis, design, and implementation of information systems, or produce information research reports of a fairly high standard on special topics. Ability to train and guide the work and study of mid-level scientific and technical information personnel and candidates for master's degrees. Plus one of the following qualifications: a doctor's degree, over 3 years' work experience as engineer, and satisfactory evaluation; or graduation from college, over 5 years of experience as engineer, and satisfactory evaluation.

C. Qualifications for Appointment to Library Posts

1. Clerk. Graduation from college; or graduation from technical secondary school, involvement in the basics of materials management, 1 year of practical training, satisfactory performance, and elementary knowledge of one foreign language.

2. Library aide. A master's degree or graduation from graduate school; or a bachelor's degree or graduation from college, with 1 year of practical training; or graduation from a polytechnic, 3 years of work experience in documents management; or graduation from a technical secondary school and over 5 years of work experience, plus the following qualifications:

a. a basic grasp of the fundamentals of the specialty concerned and professional knowledge;

b. knowledge of the basic methods and techniques of documents management and processing. Familiarity with library resources. Ability to use catalogs, union catalogs, and other reference tools to conduct searches in books, periodicals, and other documents and materials;

c. ability to carry out detailed work in a certain area under the direction of senior and mid-level materials management personnel; and

d. knowledge of one foreign language.

3. Library assistant. A doctor's degree; or a master's degree with one 2 years work experience; or a bachelor's degree or graduation from college with 4 years of experience as library aide, plus the following qualifications:

a. a fairly firm grasp of the basic knowledge of the post concerned and professional knowledge. Familiarity with the general methods and theories of literature search. Ability to solve problems that may arise on the job independently and to guide the work of library aides;

b. familiarity with the classification and indexing of documents. Ability to compile abstracts and indexes of the required quality; and

c. a good command of a foreign language.

4. Associate librarian. Five years of experience as library assistant, or over 3 years of post-doctoral experience in materials management, plus the following qualifications:

a. extensive scientific knowledge or a strong grasp of professional knowledge relevant to information and documents work. A systematic understanding of the processing and management of information materials. Familiarity with advanced theories, methods, and techniques, both domestic and foreign, relating to the processing of scientific and technical materials;

b. extensive work experience. Ability to direct the processing, handling, and management of information materials so as to produce notable results. Ability to solve major issues in one's work creatively. Or valuable research achievements;

c. the publication of academic papers or books of a fairly high standard or the compilation of valuable reference books;

d. ability to train candidates for master's degrees; and

e. proficiency in one foreign language. A good understanding of the present state and development trends in documents work abroad.

5. Librarian. Postgraduate qualifications with 5 years of experience as associate librarian, plus the following qualifications:

a. extensive scientific knowledge and a systematic and solid grasp of professional expertise relating to information and librarianship. Systematic mastery of and considerable accomplishments in information science and library science. Familiarity with the theories, methods, and techniques, domestic and foreign, of materials management and data processing. The publication of books or papers of academic value or the editing of reference books of academic value;

b. ability to guide the management and processing of information and materials comprehensively in a way that pays handsome social and economic dividends. Ability to solve major or critical issues in data processing creatively;

c. ability to train candidates for doctor's degrees;

d. proficiency in more than one foreign language. A thorough understanding of the current state and development trends in information work abroad.

D. Qualifications for appointment to translation posts:

1. Assistant translator. A master's degree, graduation certificate awarded by a graduate school, or a second bachelor's degree; or a bachelor's degree or graduation from college, with 1 year of practical training; or graduation from a polytechnic with over 3 years of experience in translation, plus the following qualifications:

a. some knowledge of a foreign language and basic professional knowledge;

b. ability to complete translation and interpreting assignments on schedule and at the required level under the guidance of senior and mid-level translation personnel;

c. ability to interpret to convey the intent of both parties, using essentially correct language and tone. Ability to translate to show an understanding of the gist of the original document, making few grammatical errors and writing coherently.

2. Translator. A doctor's degree; or a master's degree with over 2 years of work experience; or graduation from college with 4 years of experience as assistant translator; or over 4 years of experience as assistant translator plus the following qualifications:

a. a systematic grounding in a foreign language. Some scientific technical knowledge. A fairly high standard in the Chinese language;

b. extensive translation experience. Ability to translate and interpret materials in the specialty concerned in a foreign language independently, producing a work which flows smoothly and is accurate and free from major grammatical errors. Ability to write reasonably well. Good communication skills. Good performance at work.

c. ability to guide the work and study of assistant translators.

3. Associate translator editor. Postgraduate qualifications with 5 years of experience in translation work; or more than 3 years of post-doctoral experience in translation, plus the following qualifications:

a. extensive scientific knowledge and ample translation and editing experience. Outstanding performance on the job.

b. the publication of valuable translated papers and monographs. Substantial accomplishments in the specialty concerned. A strong ability to understand the original texts, to express oneself, and to translate and edit.

c. ability to translate information materials from two foreign languages, including one in which the individual is proficient enough to be able to translate or interpret skillfully and accurately, or mastery of a foreign language to the extent that he can translate it very proficiently;

d. ability to direct and organize translation work and train candidates for master's degrees; and

e. familiarity with translation theories and methods and the information profession.

4. Translator editor. Five years of experience as associate translator editor, plus the following qualifications:

a. extensive scientific knowledge, ample experience in translation or translation editing. Previous outstanding performance as translator editor;

b. the publication of valuable translated works or monographs or the translation and editing of important reports and works which show an accurate understanding of the original works and a flawless capacity for expression.

c. ability to translate and edit information materials from more than two foreign languages and to solve key issues and major difficulties in the course of work. Or mastery of a foreign language to such an extent that the individual has a perfect command of it;

d. ability to guide mid-level translation personnel in their work and train candidates for doctor's and master's degrees; and

e. mastery of the theory and methods of translation. Familiarity with the information profession.

E. Qualifications for appointment to publishing and editing posts:

1. Assistant editor. A bachelor's degree; or graduation from college with 1 year of practical training; or graduation from a polytechnic with more than 3 years of editing experience, plus the following qualifications:

a. an elementary understanding of the editing profession. Basic knowledge of the specialty concerned;

b. ability to express oneself in writing and identify and correct obvious errors in manuscripts;

c. ability to select topics, solicit contributions, edit, refine, and write manuscripts under the direction of senior and mid-level editing personnel and to complete assignments on schedule and in the quality required;

d. some knowledge of a foreign language.

2. Editor. A doctor's degree with more than 2 years of work experience; or a bachelor's degree, graduation from college or polytechnic, with 4 years of work experience as assistant editor, plus the following qualifications:

a. familiarity with the theory and practice of information science. Experience in the profession of information work. A systematic basic knowledge of the specialty in question;

b. an understanding of the editing profession and publishing;

c. ability to select topics and solicit contributions independently;

d. good writing and communication skills. Ability to correct and deal with errors in manuscripts properly. Ability to produce outstanding work.

e. ability to guide the work and study of assistant editors; and

f. knowledge of one foreign language.

3. Associate copy editor. Postgraduate qualifications with 5 years of work experience as editor; or over 3 years of post-doctoral experience in editorial work, plus the following qualifications:

a. extensive knowledge of natural science and social science. Considerable expertise and attainments in editing and the specialty in question;

b. familiarity with the theory and practice of information science. Solid experience in editing work. Adeptness at evaluating the quality of manuscripts. Ability to identify and resolve problems in editing work;

c. ability to make suggestions for topic selection plans and report plans. The publication of books or articles relating to the theory of information science or editing. Highly successful job performance.

d. ability to guide the work of mid-level and junior editing personnel and supervise candidates for master's degrees; and

e. basic mastery of Chinese grammar, formal logic, and rhetoric. Familiarity with the entire editing and publishing process.

4. Copy editor. Five years of experience as associate copy editor, plus the following qualifications:

a. extensive knowledge of natural science and social science. Systematic understanding of and considerable accomplishments in the theory and practice of editing work;

b. knowledge of the theory and practice of information science. Ample editing experience. Remarkable ability to judge and evaluate manuscripts. Ability to organize and guide the completion of major editing or reporting tasks. An aptitude for discovering and solving major issues in editing work;

c. the compilation of notes or teaching materials on information theory or editing or the publication of influential articles, books, or translated works. Outstanding performance on the job;

d. ability to direct the work of mid-level editing personnel and supervise candidates for master's and doctor's degrees; and

e. mastery of Chinese grammar, formal logic, and rhetoric. Thorough knowledge of the entire process of editing and publishing. Proficiency in more than one foreign language.

V. Responsibilities of Professional Technical Posts

A. The responsibilities of senior professional technical posts

1. direct and organize the execution of major projects or the solution of key issues;

2. undertake important special assignments;

3. be in charge of organizing professional technical work in a certain area;

4. organize academic seminars, appraise academic achievements, evaluate the standard and abilities of scientific and technical information personnel; and

5. train graduate students, compile teaching materials for graduate students, and guide the work and study of mid-level and junior scientific and technical information personnel.

B. The responsibilities of mid-level scientific and technical posts

1. participate in the execution of major projects;
2. complete their own tasks independently;
3. assist senior professional personnel in their work; and
4. guide and train junior professional personnel in their work.

C. The responsibilities of junior professional technical personnel

1. carry out their own responsibilities
2. complete all tasks under the guidance of senior and mid-level professional technical personnel; and
3. make suggestions to improve work.

The responsibilities of individual professional technical posts will be set forth separately.

VI. Organizations for Evaluating Professional Technical Posts

Evaluation committees (including evaluation groups) are organizations charged with evaluating professional technical personnel and determining whether or not they are qualified to hold the professional technical posts concerned. Evaluation committees (including evaluation groups) shall be composed of professional technical personnel of integrity who are fair and just in handling affairs, have a fairly high professional technical standard, or occupy relatively senior professional technical posts.

A. An evaluation committee on professional technical posts shall be established at the institute level. It shall consist of seven to nine members (including one director, two deputy directors, and four to six members) in addition to a secretary.

The institute evaluation committee shall be responsible for the evaluation, examination, and approval of all mid-level professional technical personnel in the institute and the evaluation and recommendation of senior professional technical personnel. The final examination and approval of senior professional technical personnel shall be the responsibility of the professional technical posts evaluation committee under the State Science and Technology Commission.

B. Professional technical posts evaluation groups shall be set up by various centers, offices, and sections. A professional technical posts evaluation group shall be made up of three to five members and headed by a group leader. It shall be responsible for the evaluation and recommendation of senior, mid-level, and junior professional technical personnel in its own unit.

The term of office of evaluation committees (including evaluation groups) shall be 3 years. Upon the establishment of the evaluation committee for the institute, the institute's original job title evaluation committee as well as evaluation groups shall be abolished.

VII. Evaluation and Appointment Procedures for Professional Technical Posts

A. Individuals who currently do not have a job title or who want to be promoted shall apply on their own, submitting a final work report, major achievements, and a list of achievements, together with their work plans should they be appointed. An individual who currently has a job title need only submit an application, provided the new post applied for is on the same grade as his current post or if only a change of post is requested. Individuals to be promoted (including those currently without job titles) shall all submit work reports within the specified area.

B. Junior professional technical posts shall be evaluated by the evaluation group of the unit concerned. Evaluations and comments shall be submitted in written form to the personnel department for examination and approval. It shall be the responsibility of the evaluation committee of the institute to examine and approve the appointment of individuals with no specific academic qualifications to junior professional technical posts.

C. Mid-level professional technical posts shall be evaluated by the evaluation group of the unit concerned. Evaluation comments and recommendations shall be submitted in written form to the evaluation committee of the institute for examination and final approval.

D. Senior professional technical posts shall be evaluated by the evaluation group of the unit concerned. Evaluations and recommendations shall be submitted to the evaluation committee of the institute, which shall forward its own recommendations to the professional technical posts evaluation committee of the State Science and Technology Commission. Final evaluations and recommendations shall be made by the latter committee.

E. Based on the work reports (including achievements) written by the applicant or individual recommended and actual work performance, and in the light of appointment requirements and the responsibilities of the category concerned, evaluation organizations at all levels shall evaluate and examine the applicant or the person recommended against the responsibilities and level of the post concerned. Finally, a vote shall be taken by secret ballot on the applicant. Two-thirds of evaluation committee members must be present to establish a quorum for a voting session. The number of votes cast must be more than half of the membership of the committee.

F. Should work so require and without exceeding establishment level, the leadership of the institute shall appoint professional technical personnel found to meet the requirements of the posts in question. Letters of appointment shall be sent to individuals selected and contracts shall be signed by both parties. The term of appointment shall be 3 years, which may be extended if necessary. Appointing units shall assess the professional standards, work attitudes, and performance of professional technical personnel appointed at scheduled and unscheduled intervals. Assessment results shall be entered into the appointee's performance file to serve as a basis for promotion, reward, penalty, and reappointment.

12581

CSO: 4008/2075

NATIONAL DEVELOPMENTS

OSI STANDARDS TO BE PART OF 7TH 5-YEAR PLAN

Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 19, 8 Oct 86 p 1

[Report by Zhao Xiaofan [6392 1420 0416]: "During the 'Seventh 5-Year Plan' This Country Will Formulate a Standard for Real-Time OSI"]

[Text] After nearly a year of investigative research and demonstrations, the formulation, verification, and checking of the OSI [open system interconnections] national standards, as well as the development of products in accordance with the OSI standards for the national optimized spectral computer [pujisuanji], have been included among major national science and technology problem solving projects in the Seventh 5-Year Plan.

These two projects will be centered on the OSI sub-committee (see JISUANJI SHIJIE, 1986 No 16, p 2) to organize dominant units throughout the country to join in tackling these problems. Their goals are that during the latter period of the Seventh 5-Year Plan:

1. They will formulate more than 50 OSI national standards that are equivalent to OSI international standards, as well as check some of the standard products among them.
2. They will develop OSI communications processors that meet levels 1-6 of the OSI standards for interfacing with IBM mainframes, VAX superminicomputers, and with national optimized spectral [pu] high quality microcomputers, respectively, interconnecting with open real-time systems in accordance with the OSI standards; also, to develop FTAM (file transfer and management), MOTIS (message oriented text interchange systems), and VT (virtual terminal) software for the three host computers just mentioned.

The realization of these two problem solving projects will provide a trustworthy support environment for special applications in this country (including key areas in national defense, public safety, economics, planning statistics, military affairs, personnel affairs, information, metallurgy, and confidentiality), and this point is never going to be attained by anything brought in from abroad; moreover, this will provide a stable basis for further perfection during the Eighth 5-Year Plan, for realizing a complete set of OSI standards, and for the task of information processing in this country.

12586
CSO: 4008/1015

NATIONAL DEVELOPMENTS

MODULAR MACHINE TOOL INDUSTRY IN 7TH 5-YEAR PLAN

Dalian ZUHE JIXIE YU ZIDONGHUA JIAGONG JISHU [MODULAR MACHINE TOOL AND AUTOMATIC MANUFACTURING TECHNIQUE] in Chinese No 10, Oct 86 pp 7-15

[Speech by Jin Zhenhua [6855 2182 5478], director of Dalian Institute of Modular Machine Tools, at the Modular Machine Tool Industry Workshop: "Vitalize the Machine Tool Industry to Meet the Golden Era of the Machine Industry"; date of speech not given]

[Text] In the first year of the Seventh 5-Year Plan, it has very significant practical meaning for people in our trade to gather together to discuss plans to revitalize the machine tool industry. The Machine Tool Industry Bureau attaches great importance to this meeting. Bureau Chief Liang personally listened to a briefing on the preparation of the meeting and put Dalian Institute of Modular Machine Tools in charge of the preparation. During the preparation, we received a great deal of support from other plants. We consulted major plants in the industry on the primary content and opinion of the meeting. I was asked by the Machine Tool Industry Bureau to talk about four problems in the modular machine tool industry.

A review of the progress made in the modular machine tool industry in the Sixth 5-Year Plan.

The situation the modular machine tool industry is facing and the goals of revitalization in the Seventh 5-Year Plan.

An explanation of several questions about the Seventh 5-Year Plan.

Specific measures and opinions concerning the implementation of the plan.

I. Review of the Modular Machine Tool Industry in the Sixth 5-Year Plan

The Sixth 5-Year Plan was an unusual 5-year period for the machine tool industry. In the early stage of the Sixth 5-Year Plan, the machine tool industry, which was developed as a result of building the equipment for the second automobile plant, were facing numerous difficulties as the government adjusted its priorities in economic work. We were used to the management system in which the government issues all the plans. The business was run poorly and there was little cooperation in the industry. Everyone fought for

himself so that there was very little capability to do anything. To face this situation, some businesses changed direction and altered their product lines. The industry was in stagnation. Ways to turn this situation around, to organize the industry based on the policy of "adjust, reform, reorganize and improve" to make technical breakthroughs in areas of desperate need, to develop new products, to push the technology forward, and to satisfy the needs in the economic construction in China became a very serious subject for the industry.

New direction was given to the industry through reform and lifting restrictions. In 1980 Dalian Institute of Modular Machine Tools organized the first joint entity - "Modular Machine Tool Research and Production Joint Venture." Later, on the basis of Anyang Modular Machine Tools and Tongyong Component Exhibit, we founded the "China Modular Machine Tool Assembly Corporation" in 1981. Two years later, on the basis of Modular Machine Tool Research and Production Joint Venture and China Modular Machine Tool Assembly Corporation, the "China Modular Machine Tool Corporation" was founded. In 1985, using Dalian Machine Tool Factory as the primary asset, "Dalian Modular Machine Tool Corporation" was established. The joint entities were established and developed with the concern and attention of the leadership on the ministry and bureau level. In many occasions, they send people to give guidance to our work. The industry was organized. A number of key personnel were stabilized to make the industry grow.

A review of the 5-year period between 1981 and 1985 showed that the modular machine tool industry had 10 major accomplishments:

1. Joint ventures were set up to expand the production capability of machine tools. In the 5 years, 3500 units of machine tools and 10,000 sets of universal tools were manufactured. The total value of the products is over 220,000,000 yuans. If modular machine tools put together by the automobile and agricultural machine manufacturing industry are included, it is estimated that over 7,000 units were made by the major industries.

2. In the 5-year period, not only the quantity produced increased significantly but also the level of modular machine tool improved by a large margin. Some key technical problems which had been around for a long time were resolved. A number of technologically advanced products related to modular machine tools were developed. Some of them are comparable to foreign products made in the late 1970's and early 1980's.

3. In the Sixth 5-Year Plan, Dalian Institute of Modular Machine Tools and Dalian Machine Tool Factory were involved in building up a research base and in technology reform which significantly enhanced the ability of the industry to perform research and development and improved the productivity of the industry.

4. The establishment of a quality inspection center for machine tool products, the restoration of the quality inspection work in the trade, and the completeness and perfection of quality related standards to improve product quality in the industry.

5. The industry is growing steadily, essentially creating a structure consisting of major machines, parts and accessories.

6. The plants in the industry made wide lateral contacts to open new avenues. The economic benefit improved significantly.

7. Management and organization in the production of machine tools have improved noticeably. Through an industrywide reorganization, some businesses were named leading units in reorganization by cities and provinces.

8. Under the guidance of the policy to make things happen, by visiting foreign countries and importing technology, the technological advancement of the industry has been stimulated.

9. As we expand the scope of services, adjust the product structure, bring in advanced technology, and develop new products, the coverage of machine tool products is enlarged. Its ability to satisfy the needs of the customers is enhanced.

10. Dalian Institute of Modular Machine Tools has quite a few research achievements. Over 70 percent of the achievements have been applied. It is gradually becoming the technology development center of the trade.

These results obtained in the Sixth 5-Year Plan made the foundation of the modular machine tool industry ever more solid. Its capability is also stronger. It will serve as a new starting point for the work to be completed in the Seventh 5-Year Plan.

II. Situation Facing the Seventh 5-Year Plan and Development Goals

The Seventh 5-Year Plan is a key period for China to build a solid foundation to vigorously develop its industry. It is a crucial period to switch from the old system to the new. It is also a crucial period for the machine industry to grow and for the machine tool industry to develop new products, improve quality and catch up with the state of the art. Vice Minister He Guangyuan [0149 0342 6678] pointed out in the National Machine Industry Workshop that the objective situation in the Seventh 5-Year Plan has a two fold impact on the development of the machine industry. On one hand, there will be a record demand. On the other hand, the opportunity is also tremendous. This is also an overall summary of the situation we are facing. Whether we can recognize this opportunity, play catch-up and vitalize the modular machine tool industry is the key issue concerning the well being of this industry.

1. Why do we want to develop the machine tool industry?

The Seventh 5-Year Plan is an important era for the Chinese economy to take off. It is also a key stage in which the modular machine tool industry will grow. Now the industry adapts to the development of the national economy in the Seventh 5-Year Plan and how the industry can perform well in this period of time require a strategy and a set of goals. We need a development plan. The development of the modular machine tool industry primarily depends on three objective changes:

The first change is that the era of importing electrical and mechanical machines in large scale is over. This not only puts pressure on the machine building industry but also brings in a golden era for the industry.

Premier Zhao recently pointed out that the era of large scale importation of electro-mechanical goods is over. Any product that can be manufactured domestically cannot be imported. The government will only spend its limited amount of foreign exchange to bring in advanced technology and key equipment not available in China.

Earlier, many industries imported a considerable amount of modular machine tools from abroad. This is due to inability of the domestic industry to address technology, quality and manufacturing cycle issues. The era of importing a great deal of electro-mechanical products is past. There is no doubt that this will put more pressure on this industry to make major breakthroughs in quality, precision and standard of modular machine tools. In addition, fundamental changes in quantity and delivery dates must be made. In this key juncture, it is really important to grab this opportunity to improve on quality, precision and standard. The show has already begun and we are the major players.

The second change is that the major support industry -- the automobile industry is growing strong, which directly demands more from our industry.

The experience from developed nations tells us that the growth in the automobile industry often is the driving force for the machine tool industry especially the modular machine tool industry, to move forward. Our experience also proved this view. In the early 1970's, we relied on our technical reserve and production capacity to complete the mission of equipping the "Second Automobile Plant" in about 3 years, providing more than 680 modular machine tools including 34 automated production lines. The equipment we supplied met the standards in the 1960's. As a result, the industry also grew with this experience. However, the requirements of the automobile industry have far exceeded the level in the past. The automobile industry not only has increased its throughput significantly but also has developed and imported a variety of advanced products. The industry more or less represents the late 1970 early 1980 level. In the Seventh 5-Year Plan, how the modular machine tool industry meets the requirements of the automobile industry while maintaining its quality level is not only a demand but also an opportunity for our industry. It will basically indicate that this industry has caught up with the level of the trade in foreign countries in the late 1970's and early 1980's. How to take this opportunity to accurately set a policy to determine the direction and strategy of growth in order to vitalize the machine tool industry is a serious problem facing us right now.

The third change is that as a result of the reform of the economic system and the R&D system, a market economy has been created. The products and technologies of the industry must enter the market. The level of the products and technologies, as well as the quality of the products and achievements, must be tested by the market. The machine tool industry in China, the equipment manufacturing plants under other ministries, and other machine tool

with their own advantages by improving the level and quality of their products and technical accomplishments to invade our market. Rigorous competition forced us to organize to improve quality and standard, to strengthen management, and the vitalize the industry. The situation demands us to come up with a comprehensive and feasible strategy and to set goals for the vitalization of the industry.

2. How do we determine the development strategy?

In order to have the correct strategy, it is very important to accurately understand the situation. Only by thoroughly understanding the environment and the position we are in will we be able to realize our responsibilities. Then, we can accurately define goals for the industry.

What is the situation we are facing? How can we assess our own position?

The automobile industry is a key industry in the economy. It is the heavy weight of machine building industries. This is the policy of the government. It will be the key industry to serve and to equip by the modular machine tool industry in the Seventh 5-Year Plan. The objective of our industry is to serve the automobile industry in production expansion and model change. Our growth plan must be drawn to aim at the needs of the automobile industry and other industries as well.

a. In the Seventh 5-Year Plan, The automobile industry will be producing 560,000 cars a year by 1990 and the capacity will reach 700,000 by then. In reality, the net increase in production capacity in the 5-year period is 300,000.

Based on the estimate given by a foreign expert, a production capacity of 10,000 automobiles will require \$200,000,000 in investment. Our experience in China indicates that it will at least cost 200 - 300 million yuan to build the facilities to produce 10,000 automobiles per year. Most of the investment is spent on purchasing advanced machine tools. The needs of the automobile industry are concentrated on high efficiency, high precision, automated, large scale, specialized equipment. In modular machine tools, the needs are focused on quality and quantity. It is very difficult to meet these needs. The pressure put on our industry is very high.

In the Sixth 5-Year Plan, although we were successful in accomplishing several major tasks aimed at the automobile industry, however, the precision requirements of the major components of the new car models far exceed the specifications we had to meet before. In the automobile industry, technologies are mostly imported for production expansion, model change and product improvement. These activities in the automobile industry not only demand us to supply a large number of modular machine tools fast, but also require us to raise the precision and improve the quality and reliability of our products.

b. Other industries will grow rapidly in the Seventh 5-Year Plan which will impose new requirements on our industry. For example, the production capacity

and variety of tractors, internal combustion engines, engineering equipment, mobile loaders and cranes will increase significantly in the Seventh 5-Year Plan. The electrical machine industry will grow even more. The production capacity of large, medium and small electrical machines, and microelectronic devices will double or triple. Highly efficient automated equipment is required to improve the technology for model conversion and production capacity increase. These products belong to a high variety, medium volume group which particularly requires flexible, semi-flexible variable and adjustable modular machine tools. The industry will have to work very hard to achieve that.

c. In the strategic plan to vitalize the machine tool industry in the Seventh 5-Year Plan, the Ministry of Machine Building sets the following requirements for our industry. We must improve the accuracy of the modular machine tool and accomplish our national key projects for the 1980's, particularly the vital components needed by the automobile industry. We have to turn the situation around from depending upon imports. We must provide better services to the users as a good designer to allow modular machine tools to be applied to wider areas to satisfy the needs of more trades. In the Seventh 5-Year Plan, we will produce small batches of flexible manufacturing units and robots in order to offer a small quantity of flexible manufacturing systems based on customer demand. We will study and develop various CAD systems and establish a comprehensive quality management and monitoring system for the modular machine tool industry in order to realize our goal that "quality comes first". The mission we are facing is tremendously important and terribly difficult.

In the Sixth 5-Year Plan, because the industry strictly implemented the line, directions and policies set by the Chinese Communist Party, we were able to grow amidst reform and achieved the ten accomplishments mentioned earlier. We made a lot of progress in that period and acquired substantial experience in dealing with development projects. These are very positive results which give us confidence to succeed. Nevertheless, we also have serious problems. In summary, our capability is not strong enough and our reputation is not well established.

For quite a long time, the modular machine tool industry is concentrated on "high volume" products. The ability to develop new products is relatively poor. There is no sufficient technical capability to resolve problems with high efficiency, high precision and automation. We have problems such as few variety, low precision, poor variability, low accuracy stability, poor reliability and long design and manufacturing cycles. In the Sixth 5-Year Plan, we proposed four major improvement tasks to raise the precision of the modular machine tool, improve its reliability, increase its adaptability and variability and improve the modular machine tool technology to make it easier to form a complete machine set. In the area of precision, we made some significant progress. In the area of adaptability, some progress was made by changing the main gear box. In terms of reliability, some progress was made by improving the electrical and hydraulic control systems and by using programmable controllers. In terms of ease of forming a complete machine set, some improvement was made through development of functional components. However, these problems have not yet been totally solved.

The industry has already formed a system consisting of plants for producing main units, for components, and for assembly as a result of the Sixth 5-Year Plan. However, we must also consciously be aware that the technology, product quality, management skill and the understanding of the significance of quality and standard are far apart from the kind of requirements to be met as an industry to tailor make advanced equipment to support other industries. Our facilities are not suited for the manufacture of modular machine tools.

Based on a thorough understanding of the environment, the current situation and the status of the industry, we can naturally reach the following conclusions. The industry must have a good plan to organize itself to meet the challenges. It must set strategic goals to respond to the new pressure. This involves organizing the entire industry to focus on the needs of the automobile industry. We must aim at developing new products through improving quality, precision and standards by implementing the "four improvements". The industry must overcome 16 key technical issues by finishing 40 studies in order to solve the four major problems in modular machine tools. Then, the "five transitions", which are the strategic goals in the modular machine tool development plan, can be realized. The "five transitions" are:

1. Transition from only being able of offering users modular machine tools of conventional precision to being able to offer high quality, reliable, high performance modular machine tool of conventional precision as well as high efficiency machine tools of high accuracy.
2. Transition from only being able to supply main units to being able to supply ancillary equipment for washing, detecting, cooling, lubricating, etc. as well.
3. Transition from only being able to supply the so-called "rigid" machine tool of a single kind in large quantity to being able to offer a variety of flexible equipment in medium quantities as well.
4. Transition from barely meeting user's need to not only meeting the need but also being able to actively push the technology forward for the user with some room for improved precision.
5. Transition from a "large and complete" or "small and complete" production management system to a specialized cooperative production management system.

These "five transitions" are not equal in weight. They are interrelated, as well as relatively independent. The first problem to resolve is to be able to supply high quality, reliable, high performance machine tools of conventional precision as well as high efficiency, high precision modular machine tools. The latter is the key. The next problem is the assembly of the main machine with its ancillary equipment. We have to pay attention to various functional components and accessories. Only by thoroughly understanding the requirements and the mission on our shoulders, and by treating the implementation the five transitions as the common goal of the industry in the Seventh 5-Year Plan, can the modular machine industry make giant progress by riding together with the automobile industry.

III. Explanation of a Few Points in the Seventh 5-Year Plan

One of the purposes that the Machine Tool Industry Bureau held this workshop is to explore how the industry can draw up a plan for the Seventh 5-Year Plan. Let me make a few points with regard to this issue.

A. In December 1983, a planning meeting was held in Dalian to study the technology advancement plan for the industry in the Seventh 5-Year Plan. The Machine Tool Industry Bureau officially released this plan to the entire industry in early 1984. With passing time and changing situation, some items in the plan no longer meet the new requirements and some are not perfected. In particular, how a plan can be prepared around serving the needs of the automobile industry.

The goal for technological development in machine building was set in a recently held machine building industry workshop. Through the development of major technology and organization of national technical projects, we are launching a battle to stand up on our own. Based on microelectronics and other technologies, we will accelerate the reform of the machine building industry to fundamentally solve the problems of poor quality, irrational product structure, low standards and dismal economic benefit, as well as to meet the needs in key economic projects, technology reform and intelligence exploitation. This objective is used as the guideline to modify this plan.

In modifying the plan, we aim at the "three consistencies." First, it must be consistent with the economic development strategy of the nation, which is to quadruple the gross national product by the end of this century. Half of the effort will rely on progress in science and technology. It is so on the national basis, as well as in the modular machine tool industry. Second, it must be consistent with the strategy of the machine building industry. The goal of the machine building industry in the Seventh 5-Year Plan is to let 60 percent of its major products reach the late 1970's and early 1980's level by the year 1990. The goal of the modular machine tool industry should not be lower than that. Third, it must be consistent with the strategy of the machine tool industry. The goal of the machine tool industry is to have all its products adhere to international standards if available by 1990. If such standards are not available, standards set by advanced countries will be adopted. The quality of ship-building industry products will reach the that of comparable products made in developed nations in the late 1970's and the quality of the primary products in the key industries must meet the standards of similar products in the late 1970 and early 1980 in developed nations.

The modular machine tool industry is a small part of the machine tool industry. It undertakes many focal point projects in the Seventh 5-Year Plan. Therefore, its strategic objectives should not be lower than those set by the machine tool industry in order to ensure that their goals are met. This is the basic guiding principle in the modification of the plan.

B. The modular machine tool industry must insist on the principle that "quality is number one" and use the "high technology carrier" concept in research and development to stimulate the growth of the field.

The major problem in the modular machine tool industry is not limited to low production volume. More importantly, the product level is low. We cannot compete with the imports and cannot export our products either. The key is in product quality and level. When we say "quality is number one" we mean two things. One is product quality and the other is product structure and level. Insisting on "quality is number one" is the major trend in the machine tool industry in developed nations in the world. In the Sixth 5-Year Plan, with the development of new products and application of new technology, the modular machine tool industry in China also enjoyed a substantial increase in productivity. This is also partially due to quality.

Therefore, in order to meet the desperate needs in the growth of the national economy, in the technology advancement in the machine building industry, in technology reform and in the automobile industry, the modular machine tool industry must insist on the basic principle of "quality is number one."

This policy must be implemented in practice.

First, We have to speed up the development of new products and new varieties. We will use high technology research as the core to focus on the development of high performance, high quality, high technology carrier products.

The machine tool industry plans to develop key products which are desperately needed in China. The focus is placed on developing products such as numeric machine tools, high precision machine tools, high efficiency machine tools, etc. We want to raise the technical level of our products across the line in order to change the current situation in which we are making low level products to improve the product structure. How the modular machine tool industry plans to implement this policy is a question to be answered by us.

"Quality is number one" is becoming a wider avenue which is an effective way to improve quality, standards, precision and economic benefit. To accelerate the development of "high technology carrier" products is the way to make it happen. It is relatively difficult to go along this path and we will have to endure a "painful period." Our capability in this aspect is still very poor. The Dalian Institute of Modular Machine Tools worked hard to establish a research and development base during the Sixth 5-Year Plan period. To some extent, its ability to develop "high technology carriers" was improved and consciously it gradually moved along the path of "quality is number one." In the Seventh 5-Year Plan, all plants in the machine tool industry will invest in technology reform via various means. Afterward, we believe the whole industry will implement the policy that "quality is number one."

Second, we have to expedite the completion of sound quality standards for all products and the establishment of a quality monitoring system to make sure that the policy "quality is number one" is thoroughly implemented.

In product quality monitoring and inspection, the modular machine tool industry has already fallen behind other trades in the machine tool industry. We must catch up. However, quality is not some thing that can be done in a day. We must insist on the policy that "quality is number one."

Third, in addition to improving the quality of modular machine tool products, we must also pay attention to the quality of accessories and hydraulic and electrical control systems as well. We have to put the issue of improving the reliability of modular machine tools on the agenda.

The users are stressing the reliability issue lately, which is also a quality issue.

Therefore, the industry must address the reliability problem as well.

C. Speed up the development of functional components and improve product level and the capacity to make complete assemblies.

A main unit is an integrated piece of machinery consisting of components with independent functions. The main unit has its specific overall function. Each component has its own function as well. These components are called functional components. In modular machine tools, various components used are all functional components.

When a modular machine tool factory in a developed country manufactures a machine tool today, most functional components are purchased from external vendors. Only 20 - 30 percent of the parts are made in-house. Because the manufacturing of functional components is specialized, their performance and quality continue to improve. Consequently, the level of the main unit is also improved. This is an important characteristic of the modern machine tool manufacturing industry. Due to the specialization of the production of functional components, the main unit manufacturer can dedicate its resources in the production of key parts and in the assembly and testing of the entire unit. The factory studies the technology employed by the user to make it satisfy the user's need better. Thus, the development of new products is accelerated, the production cycle is shortened, and the economic benefit is improved.

The modular machine tool industry has infinite advantages in this area. There is no doubt that the level of specialized manufacturing ought to be improved. In reality, it is not the case. To this end, we must take a leap in the realization of specialized production of functional components by fundamentally changing from a "large and complete" or "small and complete" production mode in order to make a significant breakthrough in the Seventh 5-Year Plan.

D. Emphasize flexible modular machine tools to meet the need of large scale production of a variety of products.

The modular machine tool industry must put its emphasis on adjustable and variable (or semi-flexible) products to accelerate the development of functional components which are adaptable to a variety of products. Dalian Institute of Modular Machine Tools will speed up its development of common parts for digital modular machine tools with ac speed adjustment and rapidly promote them in a range of applications. The development of a high pressure washing machine and a burr remover will be firmly grasped. Through

development of functional components and enhancement of capability to form a complete set, the urgent user demand for adaptable high performance equipment can be met as early as possible.

E. Push for cooperation between R&D and production and between industries to improve collective advantage and adaptability of the modular machine tool industry.

Developing lateral economic cooperation is an effective way to break away from regional and departmental constraints and to change from the "large and complete" and "small and complete" production mode. We have already proved the effectiveness of cooperating for better profit, higher speed and improved standard. In the modular machine tool industry, an entity combining R&D with production has been established for 5 years. Significant technical and economic benefits have been obtained in joint management, joint design, joint projects and collaboration in research and development. The primary purpose of the joint entity is to move the technology forward and to improve the absorption of technical accomplishments to make science and technology more effectively stimulate economic growth.

Although Dalian Modular Machine Tool Corporation was founded only a little over a year ago, its organization expanded very quickly. A great deal of progress has been made in production management activities. An industrial entity is shaping up. In summary, joint effort gives us advantages, promotes technological development and expands production. Joint effort can result in a better cooperative network to satisfy the needs and demands of the users. However, there are obstacles hindering lateral cooperation. The purpose of distributing the two documents, "Opinions on Problems Associated with Further Promotion of Lateral Cooperation in the Modular Machine Tool Industry" and "Bylaws of the Modular Machine Tool Society," is to facilitate the discussion of how our industry can be better organized to have an unanimous understanding in the promotion of lateral cooperation. In addition to joint ventures between businesses and between R&D and production, a preparatory organization will be created to coordinate all the projects in order to utilize all possible advantages to allow the industry to better serve the the national economy by supplying more high quality modular machine tools and special equipment to users in the automobile and agricultural machine industries.

IV. Measures and Opinions Concerning the Implementation of the Plan

To vitalize the modular machine tool industry and to meet the golden age of the machine building industry is a difficult task with heavy burdens. We must continue to insist on the four basic principles set by the Chinese Communist Party to continue with in-depth reform. Using the plans set by the government and the Machine Building Industry Bureau for the Seventh 5-Year Plan as the guideline, we must thoroughly implement them starting from each individual unit. We must enthusiastically execute the policy of the Chinese Communist Party of focusing on reform. It will be used as the driving force to push everything forward. We must also insist on developing material construction along with spiritual construction. We have to stimulate the enthusiasm of the vast majority with revolutionary ideology to contribute to the effort of vitalizing the machine tool industry and altering its image.

The following is a list of six comments on the implementation of the plan.

A. Organize the industry to fight for quality, precision, standard and new products with all the strength available in the industry.

As a result of the Sixth 5-Year Plan, the modular machine tool industry developed a number of precision products. The anticipated growth of the automobile industry in the Seventh 5-Year plan will impose new requirements on the quality and standards of the modular machine tool industry. In the "modular machine tool technical service inquiry meeting" held last month, representatives from various automobile factories pointed out that the precision required in machining major parts has been raised by one to one and half order of magnitude. Meeting these precision requirements is an important issue facing the industry. In the past we often blamed the imports for affecting the growth of the domestic machine building industry. Many comrades in user organizations said that they did not prefer to import which generally costs 5 - 10 times more than domestic products. The key issue is that domestic products cannot meet the requirements for precision. If the quality is satisfactory and the technology is updated, then they would be willing to buy domestically made products even it takes longer to deliver.

To this end, we must organize the entire industry in the Seventh 5-Year Plan to fight for improved quality, precision and standards and for the development of new products. The purpose of the fight is to make a gigantic leap in technology. We must have the capability to develop high efficiency, high precision, fully automated products. The target of this campaign is to satisfy the need in the automobile industry. Through this campaign, the needs on both sides will be met; i.e. needs in large scale production as well as in small and medium scale batch production. This campaign is aiming at 16 key projects in four areas. We plan to develop some products. This is the next joint activity of the trade after the construction of the Second Automobile Plant.

In order to ensure the success of the campaign, we must first have the same common understanding, define the tasks and establish a coordinating organization to control the implementation of the plan. After the meeting, we will organize the relevant plants to make arrangements for this campaign and draw up a detailed work plan. We hope that all plants can choose the appropriate people to participate in this work. We will have to create the necessary system to support this effort with money and materials.

B. Strengthen the quality monitoring system to rigorously implement the policy that "quality is number one" to give top priority to improvement of product quality.

Improving product quality is a basic function of the business. Quality involves many aspects. A business earns its reputation by the quality of its products. With regard to this vital problem which threatens the existence of the business, many businesses have gathered quite a lot of successful experience, including overall quality management, quality indicator analysis, and solidification of soft indicators. Internally, we have to begin with

improving management and strengthening discipline. Externally, we have to quickly establish a healthy product quality inspection system. We have to speed up the construction of the "China Modular Machine Tool Products Quality Monitoring and Inspection Center," complete all quality related standards, and bring the quality standard setting work into the agenda. The specific standards must be higher than the national standards.

In the document distributed in this meeting entitled "Quality Management and Quality Monitoring Plan for Modular Machine Tool Products in the Seventh 5-Year Plan," it is proposed to build three systems by 1990. They are the quality assurance system, quality monitoring and legislation system and quality information system. This is an absolutely necessary step to improve the quality of products manufactured in this trade. All comrades are requested to discuss and review the plan with regard to standardization, quality and information in the Seventh 5-Year Plan. All plants are encouraged to participate in this work.

In conclusion, we have to work solidly to raise the quality of our products to a new level. We must also handle after-sales service well. The customer service training class held at Dalian Machine Tool Plant is a very good experience. The other reason to provide good customer service is to get user feedback in order to improve our work.

C. Using common components in modular machine tools is the trend. We must accelerate the replacement of common components.

As the automobile industry grows, from the user's point of view, whether in operation and maintenance or in in-house modification to meet certain technical requirements, the machine tool industry should adopt a set of common components not only in size but also in structure. It is time to replace old components with standardized common parts. The situation requires us to stand tall and face the nation, especially the automobile industry, when dealing with the common component problem.

By insisting on the principle that "we will take charge to consolidate the attractive features to create a special system" in developing the common components and working hard toward that goal, we will be able to finish a complete series of high performance common components which are suitable for use in China.

D. Further promote lateral cooperation within the industry and strengthen the backbone team in the industry.

"We need 'stars' to lead the society and our industry to march forward." In our trade, we must establish a structure in which the backbone business is joined with the ordinary business, complete unit is combined with components and main unit is linked with accessories. Functional components will have to be developed with low cost, high quality and short cycle in mind to promote the main unit.

In order to adjust the structure of the industry and to organize the backbone team, we have to widely promote lateral cooperation. In "Views Concerning the

problems Associated with Further Promotion of Lateral Cooperation", we presented the significance of joint effort. All plants are encouraged to utilize their advantages to form various joint ventures in order to organize the industry to engage in joint projects, joint research, joint development, and joint production to push the industry forward, to advance the technology, to improve the ability of the industry to absorb technical accomplishments and to conduct R&D, and to develop better, more specialized, high efficiency, high precision products to arm the national economy and to meet the needs in the automobile industry.

E. Rigorously implement the plan to "improve management and standards in order to raise the quality of the entire industry."

In the Seventh 5-Year Plan, we must improve product quality, reduce material consumption, and increase economic benefit. These will be used as the criteria to judge the level of business management. The State Council recently released its "Decision on Problems Concerning Strengthening Business Management in Industry" and listed the major standards set for special, first and second class businesses on the national level and for advanced businesses on the provincial level. Every province, city and autonomous region must also set its review standards. How to guide a business to put its hand on management, to improve its overall quality and to exploit its total potential is also an area to address to in our industry.

To move the business to a higher level by "improving its overall quality" is a new situation in the Seventh 5-Year Plan. It is also an extension of the re-organization in the preceding 4 years. We do not have enough experience in this area. We have to take all aspects into consideration to handle this job well from all angles.

The quality management work must be preceded by ideological education. We have to solve the problem of awareness first. In particular, we must take care of the concept that technology is important and management is not insignificant. If we do not put some emphasis in this area to resolve it quickly, this will directly affect our effort to improve the industry to a higher level.

To improve and strengthen management to raise the overall quality is a very important task to be dealt with without delay. Because different levels of standards have been set any business can start at a different point, aiming at different goals to move forward, based on its own situation. The quality of the industry will be significantly improved as a result.

F. Strengthen technical training to improve the quality of the team.

The modular machine tool industry is a technology concentrated industry which requires a well trained team of technical staff, management personnel and workers. The quality of the team is not very high yet. The level at each plant is not balanced. The workers basically underwent a double course in culture and fundamental technology. The training in medium-level technology has just begun. This does not meet the needs of the business. The government has very high requirements in this area. By 1990, 50 percent of the

production workers must meet the standard set for middle level technical workers. Our industry should shoot for more. In the training of technical and management personnel, the government also set some standards. Each plant is expected to do its best in training. A detailed plan should be drawn for implementation.

In addition, we must combine the special features of our industry to hold special training lessons such as in design, testing, standardization, and quality monitoring. We have to include the exploitation of intelligence and improvement of team quality into the daily agenda.

There is a need to hold this meeting in the first year of the Seventh 5-Year Plan. It is timely. The purpose is to summarize the experience gathered in the Sixth 5-Year Plan and to draw up the technology development and production plan in the Seventh 5-Year Plan in order to mobilize the entire industry to launch a campaign to improve quality, precision and standard and to develop new products. We will use the "four improvements" as the guideline in order to realize the "five transitions," to further promote lateral joint ventures, to organize cooperation by specialty, to accelerate the replacement of common components for modular machine tools, to rigorously implement international standards, to vitalize the industry, to meet the needs of the economy and the automobile industry, and to welcome the golden era of the machine building industry.

The mission facing us is honorable and difficult. The opportunity is tremendous. It requires everyone to work jointly to vitalize the industry. We must insist on reform, work hard for the prosperity of the country, and make forward progress. We must insist on the basic policy of "quality is number one" and fight side by side for the realization of the goals set for the Seventh 5-Year Plan. Then, victory for sure will belong to us.

12553
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NATIONAL DEVELOPMENTS

MODEL ZHS-R002 PNEUMATIC ROBOT DESCRIBED

Dalian ZUHE JIXIE YU ZIDONGHUA JIAGONG JISHU [MODULAR MACHINE TOOL AND AUTOMATIC MANUFACTURING TECHNIQUE] in Chinese No 4, April 86 back cover

[Unattributed article: "Brief Introduction of the Model ZHS-R200 Pneumatic Industrial Robot"]

[Text] The Model ZHS-R002 pneumatic industrial robot (see photograph on the cover) has 5 programmable degrees of freedom. It is suitable for the automatic loading and unloading of parts in various processes, as well as in transport and conveyance operations. It can be effectively used in machining, pressing, plastic molding, pressing of refractory materials, and heat treatment. Therefore, this type of robot has a bright future in machine making, plastic products, light industry, electric appliance manufacturing, food, medicine, and military engineering. In the development and application of industrial robots abroad, pneumatic robots have made a significant impact.

This industrial robot is driven by compressed air. Its power source is easily accessible and it does not pollute the environment. It is fast and is easy to maintain. It can work safely in adverse environments, even in combustible and explosive environments. These advantages make it easy to promote its use in a variety of applications. The ZHS-R200 pneumatic robot is based on a modern compact design. Its movement is flexible and its performance is dependable. It is equipped with an automatic overload protection mechanism. It can be operated safely, easily and reliably. It is simple to maintain and inexpensive to make. It is highly practical to use. The control system is a programmable controller which can flexibly alter the work procedure of the robot. The program is simple to write. It is capable of automatically detecting problems, eliminating them and resuming automatic operation of the robot. In a flexible production system, it is extremely convenient to have several robots working jointly in a process.

This robot operates over a wide range of area. It can load and unload parts for two pieces of equipment automatically. Every moving part can be adjusted to move at the desired speed based on the actual need. Every moving part is equipped with a bumper, a brake and a mechanical locator. It has good location accuracy even at high speed. The hand of the robot employs an automatically centralized double palm structure to reduce the work time. It is also possible to replace different parts for different operations.

Major Technical Specifications

1. Structure: Compound cylindrical - rectangular coordinates
2. Degrees of freedom in movement - 5 degrees of freedom (not including hand movement)
3. Grab weight - 5 kg (2x2.5 kg)
4. position repeatability - ± 0.3 mm
5. Moving range and speed

arm flexing - 500 mm ($V_{\max} = 800$ mm/sec)

arm rotation - $\angle 70$ degrees ($\omega_{\max} = 90$ degrees/sec)

arm raising and lowering - 150 mm ($V_{\max} = 300$ mm/sec)

horizontal movement of the arm - 150 mm ($V_{\max} = 300$ mm/sec)

wrist turning - 270 degrees ($\omega_{\max} = 90$ degrees/sec)

tightness of the hand - capable of holding parts 25 - 65 mm in diameter (double palm, automatic centralization)

driving power - completely driven by compressed air

operating pressure - 5 kg/cm²

control - programmable controller (PC)

The arms of the robot can be set to turn at a maximum of 10 working positions. The wrist turning mechanism is composed of the rotating mechanisms of two cylinders to obtain the four wrist rotating operating positions at 0, 90, 180 and 270 degrees.

This pneumatic robot operates normally and reliably under the condition that the electric power grid fluctuates within a 15 to 10 percent range with external interference.

Because this pneumatic industrial robot was developed based on the actual production needs in China, it has significant social and economic benefits in ensuring production safety, and in improving working conditions and automation. Due to the fact that it is highly practical, it is worthwhile promoting for a wide range of applications.

(1) ZHS-R002气动
组合式工业机器人

(2)
大连组合机床研究所

Photo.

Key:

- [1] ZHS-R002 pneumatic industrial robot
[2] Dalian Modular Machine-Tool Research Institute

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CSN: 4108/2026

INTEL REAL-TIME OPERATING SYSTEM ADAPTED TO CHINESE

Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 19, 8 Oct 86 p 16

[Report by Li Ang [2621 2491]: "The iRMX 86 Operating System Can Handle Chinese Characters"]

[Text] After more than one-half year's work, the Information Department of the Beijing Great Wall Scientific Instruments Plant has recently completed the Sinicization of the iRMX operating system.

iRMX 86 is the Intel 86/300 series real-time multitasking operating system running on microcomputers, and is quite important in regards to real-time controlling and processing. The new Sinicized operating system maintains the original system characteristics and functions. It has added Chinese character processing, where the Chinese characters use 2-byte internal coding. They restructured the original operating system BIOS and interrupt management routines to allow the kernel to support Chinese character processing. Also, other software, e.g., human-machine interface commands, screen editing, line editing, and the entire set of compilers provided by Intel, as for example FORTRAN 86, PLM 86, ASM 86, and MBASIC, have all been revised to allow all ready-made software for this system to be compatible with both Chinese and Western language text. One may use, for example, Chinese-character pathnames, may randomly insert, delete, and search for Chinese or Western language text by screen editing, and may use Chinese-character strings and variable names in routines.

This system uses general purpose Chinese-character terminals as input/output display equipment. Development units have also designed a 24X24 dot matrix national standard 2-level character library MULTIBUS Chinese character card (which supports Chinese and Western language text output from 9-pin and 24-pin Western language printers and graphics display equipment), as well as the Intel iSBX 275 and iSBC 186/78 and Matrox Company mSBX 900 graphics controller cards, which allow this system to add Chinese character and graphics display capabilities. Newly developed software interfaces can install graphics display and Chinese-character printer driver routines into the kernel, providing a large number of system calls and LIB files (including support for the graphics terminal VDH-140 displaying 24X24 dot matrix Chinese characters through an RS-232 serial interface), where the user can directly use the logical names to drive the graphics and printer output equipment.

After empirical testing and refinement, this system is now being made available to users.

NATIONAL DEVELOPMENTS

NEW CHINESE-CHARACTER CODING STANDARDS PROPOSED

Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 19, 8 Oct 86 p 1

[Text] There will soon be two new national standards in this country for information interchange using Chinese-character coding, namely, the "Second Auxiliary Chinese-Character Encoded Character Set for Information Interchange" and the "Fourth Auxiliary Chinese-Character Encoded Character Set for Information Interchange." The specialist evaluations of these two national standards were completed recently in Beijing.

The formulation of national standards for these two auxiliary sets was the responsibility of the Huabei Computer Institute of the Ministry of Electronics and the National Commission for Language and Written Language, Chinese Character Department. Over 5 years time and with the strong support of pertinent specialists and units, they selected 14,852 Chinese characters from among the more than 57,000 that had been collected, with 7,426 in each of the two auxiliary sets. The rate of usage for these Chinese characters is lower than for the basic set, but they still have a certain degree of universality and applicability. The fonts are in accordance with national standards and the characters have been arranged according to the nationally determined 201 radicals.

These Chinese character codes meet the standards for expansion methods for the national standard GB2311 7-bit ASCII-coded character set. Each Chinese character is represented with two 7-bit binary codes or with two 8-bit binary codes. The character sets utilize the method of parallel correspondence coding for both the simplified and full characters. This both considers the needs for using simplified characters in most areas of this country, and also the actual situation where full characters are used in Hong Kong, Macao, and Taiwan; it can both satisfy the needs of modern Chinese character information processing and also the needs for the handling of classical texts.

They are the same as the basic set in that these two auxiliary sets are not only used in Chinese character processing, for information interchange between Chinese character communications systems, but also act as internal coding for Chinese-Western language compatible Chinese character systems, networked systems, and various Chinese language terminal, they are broadly used in Chinese character communications, information retrieval, enterprise and facility management, machine translation, and command dispatching.

The evaluation committee worked under the sponsorship of the National Bureau of Standards and the Department of Quality of the Ministry of Electronics. The conference affirmed the reasonableness and feasibility of the Chinese characters selected for the two auxiliary sets, and proposed some particular news on revision. After revision, these two auxiliary sets will become a national standards report to the National Bureau of Standards awaiting comments.

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NATIONAL DEVELOPMENTS

CHINESE-CHARACTER CONVERSION SYSTEM ANNOUNCED

Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 19, 8 Oct 86 p 18

[Report by Su Rong [5685 2837]: "Successful Development of 'Lark <--> 6th Institute' Chinese character conversion system."]

[Text] The Lark CPC-DOS is a Chinese-character OS developed by a Fujian Computer Plant, and CCDOS is the Chinese-character OS developed by the 6th Institute of the Ministry of Electronics, the Chinese-character internal coding schemes are different. The former system uses a 3-character representation method where "letter + digit + letter" represents one Chinese character, each Chinese character takes 3 bytes; the latter system uses two expanded ASCII codes to represent one Chinese character, each Chinese character needs two bytes. The methods of representing the internal coding for the Chinese characters are not uniform, which is not convenient for many users. The "Lark <--> 6th Institute" system was developed just for resolving this problem, and this system has solved the problem where Chinese-character internal coding in two different Sinicized DOS's are different. It has eliminated obstacles created by the two DOS's, and allows the full use of the characteristics of both Sinicized DOS. This system allows a user who has first used the Lark CPC-DOS to write programs and process data the convenience of then using the 6th Institute CCDOS, where the user need not manually re-enter the Chinese characters, and where original programs and data are available for use in the new operating system after conversion. This system has also paved the way for CCDOS users to use the CPC-DOS Chinese character internal coding for network communications and on-line signal exchange.

The "Lark <--> 6th Institute" system provides 5 conversion methods: 1) is to convert the Chinese characters in ASCII text; 2) is to quickly convert the Chinese characters in BASIC programs; 3) is to interactively convert the Chinese characters in ASCII text; a 4) is to convert the Chinese characters in ASCII text by stages; 5) converts the Chinese characters in ASCII text by fields. This system can convert programs and data (bases) done in BASIC, COBOL, dBASE, and WS.

This system combines the use of text menus, graphics, and sound, where prompts are clear and operation is convenient. It has been well received in the Xiamen Economic Information Center and the provincial Construction Bank.

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NATIONAL DEVELOPMENTS

AIR FORCE ANNOUNCES NEW GRAPHICS, OFFICE SOFTWARE

Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 19, 8 Oct 86 p 17

[Text] The automation work station of the Air Force Command has recently developed unique graphics processing software (MGP) and office combinational software (OCS) for the Great Wall 0520C-H microcomputer.

The MGP (Military Graphic Processing) is characterized by its handling of geographical graphics, which can be conveniently generated, edited, changed and revised, and joined and cut up, windows can be opened and enlarged or reduced, displayed or printed, together with which may be achieved the multiply recurring addition of map-related graphics, markers, characters and Chinese characters, and other information. Programs and graphics files are all optimally compressed, there is little system overhead, little memory storage, and the processing speed is quick. In addition, it may be connected together with various input/output equipment such as graphics input boards, mice, large screen display devices, multiple-pen plotters, and color dot matrix printers. This software is also provided with Chinese-character processing and telecommunications processing modules, with which there can be on-line communications with various microcomputers or with the PDP-VAX line of computers and through which field edited graphics or text files can be transmitted conveniently to another party. Menus are displayed entirely in Chinese characters, operations are simple and convenient, and they are especially suited to use by non-specialists. In addition to its suitability to military usage such as for battle commands and education and training, it is also suitable for use in the civilian sectors such as geology, mining, petroleum, and urban construction and planning.

OCS (Office Combinational Software) puts together the HW Chinese character processor as supplied with the Great Wall 0520C-H, a Chinese character dBASE III database, and list processing, printer processing, and database retrieval and statistics modules as developed by this station, all into a single entity that is of stronger capability. As far as text processing is concerned, there can be editing of formatted and non-formatted files, and there can be conversion between various combinations of text--graphics--tables on the one hand and file management source materials on the other; regarding the handling of tables, in addition to various table generation capabilities, it has the special features of being able to automatically generate database structures and command files according to table drawn on the screen, and can also

undertake retrieval and do statistics. The OCS software can effectively manage various kinds of data and materials texts and handle various tables, and can also graphically display database data. This software also uses Chinese characters for all menu displays, and is easy to learn and use.

This work station also reworked the keyboard management module of the Great Wall 0520C-H computer, allowing the simultaneous existence of 9 different Chinese character input methods, and it can also do associative input (character association or phrase association), which further improves the efficiency of Chinese character input. At the same time, they added keyboard management security routines, where only with the code for a particular input method can the code tables used by the system be most conveniently generated. At the same time, these routines also have the capabilities of learning input methods, generating dictionaries, and revising input codes.

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NATIONAL DEVELOPMENTS

DISTRIBUTED ARRAY PROCESSOR COMPUTER SYSTEM DEVELOPED

Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 19, 8 Oct 86 p 1

[Text] Computer science research work in this country has obtained yet another important achievement, a new type of computer system--the GF 10/12 distributed function array processor system has been successfully developed in Beijing and was appraised in mid-September by specialists from a Chinese Academy of Sciences organization.

The GF 10/12 system is a machine with a distributed function array processor system (GF 10) and was one of the key national science and technology projects during the 6th 5-Year Plan. The Chinese Academy of Sciences, with the cooperation of the Software Institute, the Xinjiang Physics Institute, and the Chinese College of Sciences and Technology, designed and built the system over a 3-year period.

This system is primarily made up of components like the system manager, a high-speed array processor, and interface communications processors. Peripherals are connected together in the system by processors, and the system bus under control of the communications structure also links them all into a unit.

The system is innovative in regards to software and hardware design. This is seen primarily in the following:

1. Regarding computational speed, due to its use of the concept of distributed functions, when compared to foreign commercial array processor systems of the same level, the GF 10/12 system has a higher system efficiency. Its computational speed is an order of magnitude greater than that of the VAX 11/780 superminicomputer, two orders of magnitude faster than M68000-based microcomputers, and also has a high function to price ratio.
2. In the area of operating systems, version 7 of the UNIX operating system has been successfully ported to the GF 10/12 system, and has been developed into a distributed mode.
3. Regarding user languages, because the vectored FORTRAN 77 language VF77 is provided, the user may conveniently rewrite the vectored portions of existing FORTRAN 77 applications programs using VF77. Then using VF77, the working

mode for the array processor is modular, consequently reducing the system overhead.

In the appraisal of the system, this achievement was given a high evaluation by the specialists, as they felt that its accomplishment signifies that the development of array processors in this country has reached a new level, which is of great significance for the development of our computer science and technology.

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NATIONAL DEVELOPMENTS

TEXTILE INDUSTRY INTRODUCES MICROPROCESSOR CONTROLS

Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 19, 8 Oct 86 p 22

[Text] Medium-range testing of dyeing vats is an important process in the textile products printing and dyeing industry, and use of microcomputer technology to realize the automated control of medium-range testing will aid in improving the control accuracy, in improving product quality, and in improving the conditions for manual labor. Recently, the Shanghai Textile Industrial Bureau organized the appraisal of a microcomputer series of products for dyeing vat automated control developed jointly by the Shanghai Academy of Textile Sciences, the Huagong Instrument and Meter Plant, and the Shanghai Yarn-Dyed Fabrics and Dyed Cotton Mill, and will adopt relevant measures to encourage their dissemination throughout the industry.

Over the past year, they have developed a series of products having five different types: the PC-822 and PC-823 dye vat automated control microcomputers, the MZ-310 yarn dyeing vat automated control microcomputer, sock dyeing machinery automated control microcomputer, and the model U jet cloth dyeing automated control microcomputer. The features of these products are complete, there is high accuracy in testing temperature and controlling temperature, and actual use has shown that they have an obvious effect on improving the quality of dyeing.

The primary functions of these products are:

1. They are highly accurate in testing and controlling temperature. The range of temperature testing is 0 - 150 degrees Centigrade, resolution is 0.1 degree C, temperature testing error is less than ± 0.5 degree C, and the temperature control error is less than ± 1 degree C.
2. An arbitrary dyeing technique temperature curve may be set up in stages, or a dyeing technique can be preset, where in operation the preset technique temperature curve is automatically redone.
3. When initiating temperature control, they have the feature of being able to find the temperature starting point, and can as well automatically control the circulating pump rotation or switching back and forth. When the dyeing has concluded, it is also capable of aiding control of operational sequences.

4. They can be connected to the PP-40 four-color printer to print out the temperature curves and relevant parameters for analysis or storage in files.

5. They can automatically display the set temperatures, tested temperatures, and control the deviation, and the process in motion can be inspected and adjusted at any time.

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NATIONAL DEVELOPMENTS

REASONS GIVEN FOR RAPID EXPANSION IN LASER TECHNOLOGY

Beijing XIANDAIHUA [MODERNIZATION] in Chinese No 11, Nov 86 pp 40, 41

[Article by Lei Shizhan [7191 0099 3277] and Song Guangli [1345 1639 4409]:
"Why China's Laser Technology Has Taken Off; An Interview with China's Laser
Scientist Deng Ximing"]

[Text] This year is the 25th anniversary of the birth of China's first laser. In September, 25 years ago, China's first laser device was successfully developed by the Changchun Optics and Mechanics Institute of the Chinese Academy of Sciences, and this was an important milestone on the path of development of China's laser technology. On this day which is worthy of being commemorated, we interviewed Comrade Deng Ximing [6772 6932 6900], researcher at the Shanghai Optics and Mechanics Institute of the Chinese Academy of Sciences and the pioneer in China's laser technology. We discussed with him the history of the development of China's laser technology and the uneven road it has traveled.

When discussing the background of current technology he said, "At that time the first laser in the world had just appeared. The gap between our laser technology then and the advanced levels abroad was very small. There were two reasons for this. One was that at the time China already had a definite foundation in material technology, which was the optical technology strength at the Changchun Optics and Mechanics Institute. This institute had been established in the early fifties by the impetus of the famous optics scientists Comrades Wang Daheng [3769 1129 3801] and Gong Zu [7895 4371]. In the late fifties a group of outstanding optics scientists and technologically superb optics design personnel and solid optics processing strength had assembled here and this prepared the material conditions for the birth of China's first laser. The other reason was that before the birth of the laser, we already recognized the importance of laser technology. In a great deal of national defense optics technology research China's scientists and technicians had thought about such questions as: When using the speed of light to measure distances can we eliminate distant reflectors? Can the effective illumination distance of infrared searchlights be increased from 800 meters to 5,000 meters? Etc. At the time the academic thinking at the Changchun Optics and Mechanics Institute was very lively, the scientists and technicians gave their opinions, brought up new ideas, new concepts, new methods, and new proposals, and from

from them people vaguely saw the key to expanding the range of optical technology applications, and this was changing the light source, but this change of necessity introduced new breakthroughs for optical technology."

Deng Ximing said: Although the work we are currently doing is not the first attempt in the world, yet this is brand-new work, and what we now can see is that except for one or two articles on principles and few newspaper type reports, we cannot find other materials of any reference value. All the work should be carried out on our own experimental technology foundation, new ideas should be turned into reality, but this is by no means easy. Even in laser experiments when there is laser output, everyone only half believes it. One day, Tang Xingli [3282 2502 6849], who was responsible for an important experiment, and I reported to Comrade Wang Yuanjiang [3769 0337 3068] about that day's experiment. On the basis of the experimental phenomena we discussed, Wang Yuanjiang thought that this was almost a laser. Then from the light curve on the oscilloscope screen we observed a sudden peak and snapped close range and far range photographs and recorded the F-P interference ring of the output light beam, and finally confirmed that it was a laser.

In March, 1961 the first helium neon gas laser was successfully developed with an output wavelength of $1.15\mu\text{m}$, and several months later, a red helium neon laser which had an output wavelength of 6328\AA was successfully obtained. Oddly enough, China's first gas laser was also a helium neon laser, developed in July 1963. Its output wavelength was also 6328\AA .

Laser science and technology workers have not stopped their upward climb and also began to establish a new laser corps and opened up new areas for laser applications. In early 1963, China's first laser science and technology institute—the Shanghai Optics and Fine Mechanics Institute of the Chinese Academy of Sciences—was born. Comrade Deng Ximing was the first deputy director of this institute. The experimental research on laser nuclear fusion they carried out enjoyed some reputation.

In 1963 the famous Soviet laser scientist and Nobel Prize winner Basov first proposed the idea of using high power lasers to induce nuclear fusion. Inspired by Basov and under the guidance of Wang Ganchang [3769 3227 2490] of China's older generation of physicists, Deng Ximing undertook the research topic of laser nuclear fusion, resolutely opening this new area. This project quickly became a key research topic of the newly established Shanghai Optics and Machine Institute and neodymium glass was selected as the working material for the laser, which was a courageous idea. This was because in the early sixties the output power level of ruby lasers was among the best. The Soviet Union also had made the ruby laser the high power device of the future, but Deng Ximing saw it in neodymium glass. He candidly said: others have their way of thinking, but we have our own ideas. The ruby and neodymium manufacturing methods are completely different. The ruby is a crystal material — it can be manufacturing using a crystal generating method, but due to technical limitations, it is very difficult to obtain a crystal of large dimensions. Neodymium glass material, on the other hand, can be manufacturing using ordinary

glass refining technology, and it is rather easy to obtain usable laser material of large dimensions. The history of the past 20 years proves that Deng Ximing and the others were absolutely right. The solid lasers in the world used for laser nuclear fusion now are basically all neodymium glass lasers.

The development of China's laser fusion has also been uneven. Deng Ximing said: In the beginning our level was neck and neck with that of the Soviet Union and the U.S. In 1963 we developed an O modulation solid laser. At the time we had great hopes of taking the lead. But the "decade of chaos" caused our pace to slow down. And it wasn't until 1973 that we used high power laser radiation nuclear material to obtain a neutron pulse. Unfortunately, by this time we had already fallen behind the Soviet Union, the United States, West Germany, and Japan.

However, the present situation is not like that at all. Our steps have become larger and we are advancing faster and faster. In terms of level, although we cannot say we are first rank, without exaggeration we can say that we are once again entering the ranks of advanced world levels.

Draft provided by the Science and Technology Group of the Central People's Broadcasting Station

8226/12851

CSO: 4008/26

NATIONAL DEVELOPMENTS

BRIEFS

MICROCOMPUTER PLANT AUTOMATES PRODUCTION--With key equipment imported from abroad, the Shanghai Computer Plant has put together a production line for microcomputers. Currently, they are trial assembling the Donghai series of microcomputers. This experience has shown that the performance of this assembly line is excellent, productivity is high, and the quality and technical performance of the microcomputers have been clearly improved. This production line includes completely automated equipment for the whole process that goes from the optimized testing of components and ICs to overall debugging and verification. Chief among this equipment are: equipment for optimizing burning in of ICs and their testing, equipment for checking PC boards, equipment for the automatic insertion of components, wave soldering machines, machines for the functional testing of boards, and overall debugging equipment. All of this equipment is under computer control, there is a high degree of automation, and it is of an international level of technology from the early 1980's. After this microcomputer production line was completed, annual production capacity has reached 10,000 units. [Text] [Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 19, 8 Oct 86 p 1] 12586

CSO: 4008/1015

COMBINATORIAL ENUMERATION OF KEY CODEWORDS

Beijing YINGYONG SHUXUE XUEBAO [ACTA MATHEMATICAE APPLICATAE SINICA] in Chinese Vol 9, No 1, Jan 86 pp 50-59

[Article by Liu Bailian [4091 2672 3425], South China Normal University; received 29 March 1984, revised 30 October; first paragraph is source-supplied English abstract]

[Text] Abstract: Some mistakes in [1] are pointed out and some simple recursive formulas and explicit formulations are given to solve the problem of counting the number of m -level digital sequences of length n that satisfy some constraints.

"A Combinatorial Problem and Application in Counting the Number of Key Codewords" (hereafter called [1] for short) studies the combination presented in key codewords. There are certain errors in the main summary in that article. First we list the enumeration object discussed as follows in the symbols used in [1].

Definition 1. For the m element $\{1, 2, \dots, m\}$, they can be arranged in a permutation of the n element. The set made up of all digital sequences is recorded as $Q(n, m)$.

Definition 2. For a digital sequence in $Q(n, m)$, the contiguous segment of a same digit is called a trip for this digital sequence. The number of elements contained in a trip is called a trip length. The trip length of a digital sequence is referred to as its maximum trip length.

$C(n, m, l)$ is the set of digital sequences in $Q(n, m)$ whose trip length is larger than or equal to l .

$Q(n, m, l)$ is the set of digital sequences in $Q(n, m)$ whose trip length is less than l .

$G(n, m, l)$ is the set of digital sequences in $Q(n, m)$ whose trip length is exactly equal to l .

Apparently, $G(n, m, l) = C(n, m, l) - C(n, m, l+1) = Q(n, m, l+1) - Q(n, m, l)$.

Definition 3. $b(n, m, l)$ is the set of digital sequences in $Q(n, m)$ whose final trip lengths are larger than or equal to l . $d(n, m, l)$ is the set of digital sequences in $Q(n, m)$ whose final trip lengths are exactly equal to l . $S(n, m, l)$ is the set of digital sequences in $d(n, m, l)$, inside which at least one trip length is larger than or equal to $l + 1$, in addition to the final trip length. $S_{ij}(n, m, l)$ is the set of digital sequences in $Q(n, m, l)$ whose final trip length is j and digit is i .

Definition 4. Assuming that A is a set, $f(A)$ specifies the number of digital sequences in A . Therefore, natural numbers are taken for $f(A)$.

One of the main results in reference [1] shows the simple recursive formulas for $f(G(n, m, l))$ and $f(Q(n, m, l))$, as well as the explicit formulation for $f(G(n, m, l))$ when $l \geq 1/3 (n-2)$. We concede that certain conclusions in [1] are incorrect and that the method used is also too cumbersome. Besides discussing the work in [1], this article also provides simple recursive formulas and direct-enumeration formula for easy application on the same combinatorial problem.

1.

In solving $f(G(n, m, l))$ and $f(Q(n, m, l))$, four sets which are to change value at midpoint are introduced in reference [1] (see Definition 3 in [1]), and the following result is subsequently obtained.

1. Regarding the recursive formula for $f(G(n, m, l))$,

$$\begin{aligned} f(G(n, m, l)) &= n \{ f(G(n-1, m, l)) \\ &\quad - f(d(n-1, m, l)) + f(S(n-1, m, l)) \} \\ &= [f(d(n-1, m, l-1)) - f(S(n-1, m, l-1))] \\ &\quad + (m-1)[f(d(n-1, m, l)) - f(S(n-1, m, l))] \quad (1.1) \end{aligned}$$

(i.e., Theorem 3 in [1]).

2. Regarding the explicit formulation for $f(S(n, m, l))$,

$$f(S(n, m, l)) = \begin{cases} (n-2l)m^{(n-2l)}(m-1) \\ \quad - (n-2l-1)m^{(n-2l-1)}(m-1), & \text{当 } l > \frac{1}{3}(n-2) \\ (n-2l)m^{(n-2l)}(m-1) \\ \quad - (n-2l-1)m^{(n-2l-1)}(m-1) - m(m-1)^2, & \text{当 } l = \frac{1}{3}(n-2). \end{cases} \quad (1.2)$$

(i.e., Theorem 4 in [1]).

3.

$$f(b(n, m, l)) = m \cdot m^{(s-l)}, \quad (1.3)$$

$$f(d(n, m, l)) = (m-1) \cdot m^{(s-l)} \quad (1.4)$$

(i.e., Theorem 5 in [1]).

4. Solving the explicit formulation for $f(G(n, m, l))$.

Plugging (1.2), (1.3), and (1.4) into (1.1), we have

$$f(G(n, m, l)) - mf(G(n-1, m, l)) = b, \quad (1.5)$$

where

$$b = (m-1)^2 m^{s-l-1} + (m-1) m^{(s-2l-2)} \cdot [-(n-2l+1)m^3 + (n-2l)m^2 + (n-2l-1)m - (n-2l-2)],$$

Based on $f(G(l, m, l)) = m$, solving the difference equation (1.5), we have

$$f(G(n, m, l)) = b + bm + bm^2 + \dots + bm^{s-l-1} + m \cdot m^{s-l}, \quad (1.6)$$

Substituting b and simplifying, we have

$$\begin{aligned} f(G(n, m, l)) &= m^{s-l-1} [m^{s-l+1} - m^{s-l} + m^2 - m + 1] \\ &+ m^{(s-2l-2)} \cdot (m^{s-l} - 1) [-(n-2l+1)m^3 \\ &+ (n-2l)m^2 + (n-2l-1)m - (n-2l-2)]. \end{aligned} \quad (1.7)$$

The above expression is valid when $l \geq \frac{1}{3}(n-2)$. Use the following, however, when $l < \frac{1}{3}(n-2)$:

$$f(G(n, m, l)) = f(Q(n, m, l+1)) - f(Q(n, m, l)).$$

5. Solving $f(Q(n, m, l))$

$$f(Q(n, m, l)) = \sum_{i=1}^n \sum_{j=1}^{l-1} f(S_{ij}(n, m, l)) \quad (1.8)$$

(i.e., Theorem 8 in [1], in which the solution for $S_{ij}(n, m, l)$ is assisted by the recursive formula (see Theorem 7 in [1]).

The above is the work in [1].

First of all, expression (1.7) as the main conclusion is incorrect.

Let us investigate a simple computation example to enumerate $f(G(4, 2, 3))$ using expression (1.7). Because $l = 3$ and $n = 4$, it is apparent that $l > 1/3(n-2)$. From (1.7) we have

$$f(G(4, 2, 3)) = 4 \frac{7}{8}, \text{ which is not a natural number.}$$

The correct answer should be $f(G(4, 2, 3)) = 4$.

In another example, $f(G(6, 2, 2)) = -58$, a negative number. The correct answer should be $f(G(6, 2, 2)) = 24$.

A series of errors are generated because expression (1.7) is incorrect.

1. Discussion of the formula application range is neglected.

Expression (1.7) is derived from expression (1.5), and b in expression (1.5) is related to expression (1.2). Apparently, there is a problem in expression (1.2) as well, which should be changed to:

$$f(S(n, m, l)) = \begin{cases} 0, & l \geq \frac{n}{2}, \\ (n-2l)m^{(n-2l)}(m-1) - (n-2l-1)m^{(n-2l-1)} \cdot (m-1), & \frac{1}{3}(n-2) < l < \frac{n}{2}, \\ (n-2l)m^{(n-2l)}(m-1) - (n-2l-1)m^{(n-2l-1)} \cdot (m-1) - m(m-1)^2, & l = \frac{1}{3}(n-2). \end{cases}$$

2. Variations in extreme cases for the formula are neglected.

In solving the difference equation using the recursion method, the variation in initial value (extreme case) will cause a variation in the solution. For example, expression (1.4) (i.e., Theorem 5 in [1]) should be changed to

$$f(d(n, m, l)) = \begin{cases} (m-1)m^{(n-l)}, & l < n, \\ m, & l = n. \end{cases} \quad (1.9)$$

3. Due to the above errors, when [1] employs Theorem 3 (i.e., expression (1.1)), expression (1.1) is written as

$$f(G(n, m, l)) - mf(G(n-1, m, l)) = b.$$

It is incorrect to express b uniformly using one explicit formulation. The truth is, when expression (1.1) is simplified, we have

$$\begin{aligned} f(G(n, m, l)) - mf(G(n-1, m, l)) \\ = -f(d(n-1, m, l)) + f(d(n-1, m, l-1)) \\ + f(S(n-1, m, l)) - f(S(n-1, m, l-1)), \end{aligned} \quad (1.10)$$

that is,

$$b = -f(d(n-1, m, l)) + f(d(n-1, m, l-1)) \\ + f(S(n-1, m, l)) - f(S(n-1, m, l-1)).$$

Since the explicit formulation for $f(S(n, m, l))$ has a specific applicable range, and $f(S(n, m, l))$ and $f(d(n, m, l))$ have different expressions in different ranges, then b cannot be expressed with one explicit formulation indiscriminately (see expression (1.5)). Furthermore, [1] only notes the validity of the explicit formulation for $f(S(n, m, l))$ when $l \geq 1/3 (n-2)$, but fails to provide a similar discussion on $f(S(n-1, m, l))$ and $f(S(n-1, m, l-1))$ in expression (1.10).

Therefore, discussion in terms of the different applicable ranges for the four terms to the right in expression (1.10) should have been provided. The corresponding conclusion in [1] should be changed as:

$$f(G(n, m, 1)) = m(m-1)^{n-1}, \\ f(G(n, m, n)) = m.$$

Let us investigate the situation in which $1 < l < n$. From (1.10)

$$f(G(n, m, l)) - mf(G(n-1, m, l)) = b,$$

In order to supply the explicit formulation for b , based on the result in [1], only the situation in which $\frac{n}{3} \leq l < n$ can be discussed:

$$b = \begin{cases} (m-1)^2 m^{n-l-1} + (m-1)^{(n-2l-2)} [-(n-2l+1)m^2 \\ + (n-2l)m^2 + (n-2l-1)m - (n-2l-2)] \\ + m(m-1)^2, & l = \frac{n}{3}, \\ (m-1)^2 m^{n-l-1} + (m-1)^{(n-2l-2)} [-(n-2l+1)m^2 \\ + (n-2l)m^2 + (n-2l-1)m - (n-2l-2)], & \frac{n}{3} < l < \frac{n-1}{2}, \\ (m-1)^2 m^{n-l-1} - (n-2l+1)m^{n-2l}(m+1) \\ + (n-2l)m^{n-2l}(m-1), & \frac{n-1}{2} \leq l < \frac{n+1}{2}, \\ (m-1)^2 m^{n-l-1}, & \frac{n+1}{2} \leq l < n-1, \\ m(m-2), & l = n-1. \end{cases}$$

Particular attention to the variation in n is warranted when using the recursive formula for $f(G(n, m, l))$.

II.

In addition to the above problems, the method used in [1] is overly cumbersome and is inconvenient to apply even when the result has been corrected. Even for such a common enumeration as $f(G(7, 2, 2))$, recursive formula (1.5) cannot be used because $l < n/3$. In order to enumerate $f(G(n, m, l))$ and $f(Q(n, m, l))$, we have the following new conclusion.

Theorem 1

$$f(G(n, m, l)) = (m-1) \left[\sum_{j=1}^{m(n-l, l)} f(G(n-l, m, j)) + \sum_{k=1}^{m(n-l, m-l)} f(G(n-k, m, l)) \right] \quad (n > l). \quad (2.1)$$

especially,

$$f(G(n, m, 1)) = m(m-1)^{n-1}, \quad (2.2)$$

$$f(G(n, m, n)) = m, \quad (2.3)$$

$$f(G(n, m, l)) = 0, \text{ when } n < l. \quad (2.4)$$

Proof: The digital sequences in $G(n, m, l)$ are divided into two groups.

If the final trip length is l , then after the final trip length is dropped, for the digital sequence of the remaining $(n-l)$ term, its trip length is certainly not larger than l , and its number is $\sum_{j=1}^l f(G(n-l, m, j))$. We also notice that the final trip differs from the adjacent trip digit, also $j \leq n-l$. Therefore, the number obtained is

$$(m-1) \sum_{j=1}^{m(n-l, l)} f(G(n-l, m, j)).$$

For a final trip length of less than l , we can set the length at $k (< l)$, and then after the final trip is dropped, for the digital sequence of the remain-

ing $(n-k)$ term, its trip length is l . Therefore, the number is $\sum_{k=1}^{l-1} f(G(n-k, m, l))$.

We notice that $n-k \geq l$ differs from the adjacent trip digit. The number of digital sequence thus obtained is $(m-1) \sum_{k=1}^{m(n-l, m-l)} f(G(n-k, m, l))$.

The recursive formula (2.1) is obtained when the above two expressions are combined.

Expressions (2.2), (2.3), and (2.4) are revealed using the structural method (end of proof).

From Theorem 1, $f(G(n, m, l))$ can be easily enumerated. We tabulate the computational process to facilitate easy application.

For a certain fixed m , Table 1 can be listed.

Table 1. $f(G(n, m, l))$

$n \backslash l$	1	2	3	4	5	6
1	m					
2	$m(m-1)$	m				
3	$m(m-1)^2$	$2m(m-1)$	m			
4	$m(m-1)^3$	$m(m-1)(3m-2)$	$2m(m-1)$	m		
5	$m(m-1)^4$	$m(m-1)(4m-3)$	$m(m-1)(3m-1)$	$2m(m-1)$	m	
6	$m(m-1)^5$		$m(m-1)(3m-1)$	$2m(m-1)$	m	

It can be seen from expression (2.4) that all the values in the area above the primary diagonal line are zeros.

It can be seen from expression (2.3) that all the values on the primary diagonal line are m 's.

It can be seen from expression (2.2) that the first sequence is $m(m-1)^{n-1}$.

The following enumeration rule can be obtained from expression (2.1).

Rule: To enumerate $f(G(n, m, l))$, i.e., the number for position (n, l) in Table 1, one only has to add the numbers from left to right on the $(n-1)$ th row in Table 1 to the l column, and then go down, adding every element under the l th column up to the $(n-1)$ th column. Finally, the result is obtained by $(m-1)$.

To illustrate the aforementioned summing process, it is one such summation process along a route as:

$$\begin{array}{c} (n-1, 1) \cdots \cdots > (n-1, l) \\ \vdots \\ \vee \\ (n-1, l) \end{array}$$

In Table 1, we can easily notice an interesting aspect of $f(G(n, m, l))$. That is, if one is to start from the primary diagonal line and number each diagonal line from top to bottom, in sequence, as (1), (2), (3), ..., and also number the element on each diagonal line, from top to bottom, in sequence, as 1, 2, 3, ..., then on the i th diagonal line, starting from the i th digit, each and every digit thereafter is the same. For example, on diagonal line 3, starting from the third digit, each and every number that follows is $m(m-1)(3m-1)$, respectively

The mathematics reflecting this property is described as follows:

Theorem 2. If $1 \leq i \leq \frac{n+1}{2}$, then

$$f(G(n+1, m, n+2-i)) = f(G(n, m, n+1-i)), \quad (2.5)$$

Proof: Apply inductive method in mathematics on n .

For $f(G(2, m, 3-i)) = f(G(1, m, 2-i))$, $i = 1$,
that is, $f(G(2, m, 2)) = f(G(1, m, 1)) = m$.

Assume that expression (2.5) is valid for $n-1$.

From Theorem 1

$$\begin{aligned} f(G(n+1, m, n+2-i)) &= (m-1) \left[\sum_{i=1}^{m(n+1)-(n+2-i)} f(G(i-1, m, i)) \right. \\ &\quad \left. + \sum_{i=1}^{m(n+1)-(n+1)} f(G(n+1-i, m, n+2-i)) \right]. \end{aligned} \quad (2.6)$$

We observe that $1 \leq i \leq \frac{n+1}{2} < \frac{n}{2} + 1$, that is, $n+2-i > i-1$, thus

$$f(G(i-1, m, n+2-i)) = 0.$$

The first Σ inside the bracket on the right in expression (2.6) can be rewritten as $\sum_{i=1}^{m(n+1)-(n+1)} f(G(i-1, m, i))$.

We also observe that $1 \leq i \leq \frac{n+1}{2}$, that is, $n+2-i > 1$, thus,

$$f(G(i, m, n+2-i)) = 0.$$

By inductive assumption, the second I in the bracket on the right in expression (2.6) can be rewritten as $\sum_{k=1}^{m(n-i, n-i)} f(G(n-k, m, n+1-i))$. Therefore, expression (2.6) becomes

$$\begin{aligned} f(G(n+1, m, n+2-i)) &= (m-1) \left[\sum_{j=1}^{m(n-i-1, n+1-i)} f(G(i-1, m, j)) \right. \\ &\quad \left. + \sum_{k=1}^{m(n-i, n-i)} f(G(n-k, m, n+1-i)) \right] \\ &= f(G(n, m, n+1-i)). \end{aligned}$$

End of proof.

By using Theorems 1 and 2, we need not to be concerned, as [1] has to, whether $i \geq n/3$ to solve $f(G(n, m, i))$ rather quickly. The numeration is even more convenient for m , which is more definite.

The following can be obtained instantly by definition:

$$\text{Theorem 3. } f(D(n, m, l)) = \sum_{j=1}^{l-1} f(G(n, m, j)).$$

As a matter of fact, we need not solve $f(G(n, m, l))$ but directly obtain the recursive formulation for $f(D(n, m, l))$ instead.

$$\text{Theorem 4. } f(D(n, m, l)) = (m-1) \sum_{j=1}^{l-1} f(D(n-j, m, l)) \text{ when } 1 \leq l \leq n, \quad (2.7)$$

$$f(D(n, m, l)) = m^n, \quad \text{when } l > n. \quad (2.8)$$

Proof: By definition, for each digital sequence in $D(n, m, l)$, let the length of the final trip be j , $1 \leq j \leq l-1$. After the final trip is dropped, the number of digital sequence in the resulting $(n-j)$ term is $f(D(n-j, m, l))$. Notice that the digit of the final trip differs from that of the adjacent trip. Expression (2.7) is obtained when summation is performed on j . It can be seen that expression (2.8) is valid by definition. End of proof.

The resultant function is recorded as $F_{m,n}(x) = \sum_{l=1}^{\infty} f(D(n, m, l))x^{n-l}$.

Theorem 5. $F_{m,n}(x) = \frac{m(1-x^{l+1})}{1-mx+(m-1)x^l}$

Proof: From Theorem 4

$$\begin{aligned}
 F_{m,n}(x) &= \sum_{i=0}^n f(Q(n, m, l))x^{n-i} \\
 &= \sum_{i=0}^{l-1} f(Q(n, m, l))x^{n-i} + \sum_{i=l}^n f(Q(n, m, l))x^{n-i} \\
 &= \sum_{i=0}^{l-1} m^i x^{n-i} + (m-1) \sum_{i=0}^{l-1} \sum_{j=0}^{l-1} f(Q(n-j, m, l))x^{n-i} \\
 &= \sum_{i=0}^{l-1} m^i x^{n-i} - (m-1) \sum_{i=0}^{l-1} \sum_{j=0}^{l-1} f(Q(n-j, m, l))x^{n-i} \\
 &\quad + (m-1) \sum_{i=0}^{l-1} x^i \sum_{j=0}^{l-1} f(Q(n-j, m, l))x^{n-i-j} \\
 &= \sum_{i=0}^{l-1} m^i x^{n-i} - (m-1) \sum_{i=0}^{l-1} \sum_{j=0}^{l-1} m^{n-i-j} x^{n-i} \\
 &\quad + (m-1) \sum_{i=0}^{l-1} x^i F_{m,n}(x) \\
 &= \left(\sum_{i=0}^{l-1} m^i x^{n-i} - \sum_{i=0}^{l-1} m^i x^{n-i} \right) \\
 &\quad + \left(\sum_{i=0}^{l-1} m^{n-i} x^{n-i} - \sum_{i=0}^{l-1} m^{n-i} x^{n-i} \right) \\
 &\quad + \dots + \left(\sum_{i=0}^{l-1} m^{n-i+1} x^{n-i} - \sum_{i=0}^{l-1} m^{n-i+1} x^{n-i} \right) \\
 &\quad + \sum_{i=0}^{l-1} m^{n-i+1} x^{n-i} + (m-1)x F_{m,n}(x) \sum_{i=0}^{l-1} x^i \\
 &= m + mx + \dots + mx^{l-1} + mx^{l-1} \\
 &\quad + (m-1)x F_{m,n}(x) \sum_{i=0}^{l-1} x^i \\
 &= m \cdot \frac{1-x^{l+1}}{1-x} + (m-1)x \cdot \frac{1-x^{l+1}}{1-x} F_{m,n}(x),
 \end{aligned}$$

After organizing, we have

$$[(1-x) - (m-1)x(1-x^{l+1})]F_{m,n}(x) = m(1-x^{l+1}),$$

Therefore,

$$F_{m,n}(x) = \frac{m(1-x^{l+1})}{1-mx+(m-1)x^l}.$$

End of proof.

For the solution of $f(C(n, m, l))$, in addition to using the relationship

$$f(C(n, m, l)) = \sum_{i=1}^n f(G(n, m, i)), \text{ we also have}$$

$$\text{Theorem 6. } f(C(n, m, l)) = (m-1) \sum_{i=1}^{l-1} f(C(n-i, m, l)) + m^{n-l+1} \quad (l \leq n),$$

$$f(C(n, m, 1)) = m^n,$$

$$f(C(n, m, n)) = m.$$

Proof: The consideration and idea are basically the same as in Theorems 1 and 4. Let the length of the final trip be j , and investigate the two situations where $j < l$ and $j \geq l$.

In $C(n, m, l)$, the number of digital sequence whose final trip length $j < l$ is

$$(m-1) \sum_{i=1}^{l-1} f(C(n-i, m, l)).$$

In $C(n, m, l)$, the number of digital sequence whose final trip length is $j \geq l$ is m^{n-l+1} . End of proof.

In the enumeration for $f(G(n, m, l))$ and $f(D(n, m, l))$, using the series of formulas is much more convenient than the formulas in 1. (that is, the results in [1]). Nevertheless, to solve the problem in its entirety, we still desire a direct expression. From the relationship indicated in Definition 2, we merely have to derive the explicit formulation for one of the three-- $f(G(n, m, l))$, $f(D(n, m, l))$, $f(C(n, m, l))$ --and this would mean that the problem is solved. We have:

$$\text{Theorem 7. } f(D(n, m, l)) = m \sum_{i=1}^n (m-1)^{i-1} \sum_{j=i}^n (-1)^j \binom{l}{j} \cdot \binom{n-(l-1)j-1}{l-1}, \quad (2.9)$$

where $\binom{k}{j}$ is the combinatorial number of k on j .

Proof: In an orderly manner, if we break up the k portions in n , then each portion therein is a positive number less than l . The number of these separations is recorded as $P_n^{S_{l-1}^{(k)}}$. Then in $D(n, m, l)$, the number of digital sequences having exactly a k trip is $m(m-1)^{k-1} P_n^{S_{l-1}^{(k)}}$, therefore

$$f(D(n, m, l)) = \sum_{k=1}^n m(m-1)^{k-1} P_n^{S_{l-1}^{(k)}}. \quad (2.10)$$

$p_{s,j}^{(G)}$ is the coefficient of t^j term in the resultant function $(1 + t^2 + \dots + t^{l-1})^s$.

$$\begin{aligned}(1 + t^2 + \dots + t^{l-1})^s &= t^s(1 - t^{2l})^s(1 - t)^{-s} \\&= t^s \sum_{r=0}^{\infty} (-1)^r \binom{s}{r} t^{2lr} \sum_{k=0}^{\infty} \binom{s+r-1}{k-1} t^k \\&= t^s \sum_{j=0}^{\infty} \left[\sum_{i=0}^{\infty} (-1)^i \binom{s}{i} \binom{s+i-(l-1)j-1}{k+1} \right] t^{s+j} \\&= \sum_{j=0}^{\infty} \sum_{i=0}^{\infty} (-1)^i \binom{s}{i} \binom{s-(l-1)j-1}{k-1} t^{s+j},\end{aligned}$$

therefore,

$$p_{s,j}^{(G)} = \sum_{i=0}^{\infty} (-1)^i \binom{s}{i} \binom{s-(l-1)j-1}{k-1}.$$

Substituting into expression (2.10), expression (2.9) is obtained. End of proof.

From Theorem 7 and the relationship between $G(n, m, l)$, $C(n, m, l)$, and $D(n, m, l)$ in Definition 2, $f(G(n, m, l))$ and $f(C(n, m, l))$ can be expressed in explicit formulas as well.

In $D(n, m, l)$, if the composite set formed by the digital sequences in each of which an m number appears is recorded, in a combinatorial manner, as $\hat{D}(n, m, l)$, then we would also have:

$$\text{Theorem 8. } f(\hat{D}(n, m, l)) = \sum_{j=0}^{\infty} (-1)^{mj} \binom{n}{j} f(D(n, j, l)). \quad (2.11)$$

$$\text{Proof: Because } f(D(n, m, l)) = \sum_{j=0}^{\infty} \binom{n}{j} f(\hat{D}(n, j, l)),$$

expression (2.11) can be instantly obtained when reversed deduction on the second-order term is performed. End of proof.

By definition, similarly combine $\tilde{G}(n, m, l)$, $\tilde{C}(n, m, l)$, which, in turn, have an enumerational relationship with corresponding $G(n, m, l)$ and $C(n, m, l)$, similar to what is shown in Theorem 8.

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UNIQUENESS OF POSITIVE SOLUTIONS OF NONLINEAR ELLIPTIC EQUATIONS

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[Text] Abstract: In this paper, we consider the problem

$$\begin{cases} -\Delta u = r(u - u)^{-\frac{1}{1+\sigma}}, & \text{in } \Omega \\ u = 0, & \text{on } \partial\Omega \end{cases} \quad (1)$$

which arises from chemical reaction theory, where Ω is a smooth and bounded domain, r , σ and k are some positive constants.

Theorem 1. Let $k\sigma < 4 + 4\sigma$; then problem (1) has a unique positive solution.

Theorem 2. Suppose $k\sigma \geq 4 + 4\sigma$, $r < \frac{k}{k + 4 + 4\sigma} \exp \frac{k + 2 + 2\sigma}{1 + \sigma}$; then problem (1) has a unique positive solution, where λ_1 is the first eigen value of the problem

$$\begin{cases} -\Delta \varphi(x) = \lambda \varphi(x), & \text{in } \Omega, \\ \varphi = 0, & \text{on } \partial\Omega. \end{cases}$$

The boundary value and eigen value of a nonlinear elliptic equation which arise from nonlinear diffusion process theory and nucleus/chemical reaction theory are only concerned with positive solutions. The Dirichlet problem of a nonlinear elliptic equation which arises from a chemical reaction theory is discussed in this article, proving the uniqueness of positive solutions when parameters are at some definite points.

The problem we are discussing can be summarized to prove [1]:

$$\begin{cases} -\Delta v = r(1 + \sigma - v)^{-\frac{1}{1+\sigma}}, & \text{in } \Omega, \\ v = 1, & \text{on } \partial\Omega \end{cases} \quad (1)$$

where Q is a smooth and bounded domain whose boundary is ∂Q , and γ , σ , and k are some positive constants. If $u = v - 1$, then problem (1) becomes:

$$\begin{cases} -\Delta u = \gamma(\sigma - u)e^{-\frac{1}{1+u}}, & \text{in } Q, \\ u = 0, & \text{on } \partial Q. \end{cases} \quad (2)$$

Obviously, $u_1 = \sigma$ and $u_2 = 0$ are, respectively, the upper and lower solution for problem (2). Thus problem (2) at least has one positive u satisfying $0 < u < \sigma$.

Amann [2] once discussed the existence of multiple positive solutions for problem (2). Nevertheless, under what conditions are the positive solutions unique? It is an answer needed in practical use.

Theorem 1. Set $k\sigma < 4 + 4\sigma$, then problem (2) has a unique positive solution.

Proof: What is to be proved is the uniqueness of positive solutions.

First, we will prove that any positive solution of (2), $u(x)$, must have $u(x) < \sigma$. Otherwise we let $Q_1 = \{x \in Q | u(x) > \sigma\}$, then

$$\begin{cases} -\Delta(u - \sigma) = \gamma(\sigma - u)e^{-\frac{1}{1+u}} < 0, & \text{in } Q_1, \\ u - \sigma = 0, & \text{on } \partial Q_1. \end{cases}$$

Therefore, by the principle of extreme value, it can be seen that inside Q , $u < \sigma$, a contradiction.

Record $f(\xi) = \gamma(\sigma - \xi)e^{-\frac{1}{1+\xi}}$, then $f'(\xi) = \frac{\gamma}{(1+\xi)^2}[(\xi(\sigma - \xi) - (1+\xi)^2)]e^{-\frac{1}{1+\xi}}$.

When $k\sigma < 1$, then $f'(\xi) < 0$. When $k\sigma > 1$, record the positive root of $f'(\xi) = \xi(\sigma - \xi) - (1+\xi)^2 = 0$ as b , then $0 < b < \sigma$. In addition, $f'(\xi) = -\xi - 2(1+\xi) < 0$. Thus, when $0 < \xi < b$, $f'(\xi) > 0$, but when $b < \xi < \sigma$, $f'(\xi) < 0$. Furthermore,

$$\frac{d}{d\xi} \left(\frac{f(\xi)}{\xi} \right) = -\frac{\gamma}{\xi^2(1+\xi)^2} [(\xi + \sigma)\xi^2 + (2 - \xi)\sigma\xi + \sigma]e^{-\frac{1}{1+\xi}},$$

Thus, when $k\sigma < 4 + 4\sigma$, we have $\frac{d}{d\xi} \left(\frac{f(\xi)}{\xi} \right) < 0$.

It can be seen from reference [2] that problem (2) has the largest positive solution $u(x)$. If there were another positive solution $v(x)$, then on Q there is $u(x) \geq v(x)$. Now, select the largest number so that $\forall x \in Q$ having $v(x) > \alpha_0 u(x)$ can be satisfied. Such α_0 does exist, in addition to $0 < \alpha_0 < 1$. In fact, let

$$A = \{x \in \mathbb{R} | v(x) \geq \alpha_0 u(x), \forall x \in Q\}.$$

Apparently, $\alpha = 0 \in A$. Furthermore $\alpha < 1$. Otherwise, $u(x)$ being the largest positive solution would be contradicted. Thus, we have $0 \leq \alpha_0 = \sup A < 1$.

For $0 \leq \alpha_0 < 1$, when $u(x) > 0$, it can be seen from $\frac{d}{d\xi} \left(\frac{f(\xi)}{\xi} \right) < 0$ that

$$f[\alpha_0 u(x)] > \alpha_0 u(x) \cdot \frac{f[u(x)]}{u(x)} = \alpha_0 f[u(x)],$$

that is,

$$f[\alpha_0 u(x)] > \alpha_0 f[u(x)]. \quad (3)$$

It is apparent that equation (3) is also valid when $u(x) = 0$. Therefore, when $\forall x \in \bar{Q}$, (3), expression (3) is valid. Due to the continuity of $f(\alpha_0 u) - \alpha_0 f(u)$ and the bounded nature of $f(u)$ ($0 \leq u \leq \sigma$), it can be seen that $\varepsilon_1 > 0$ exists, making

$$f(\alpha_0 u(x)) - \alpha_0 f(u(x)) \geq \varepsilon_1 f(u(x)), \quad \forall x \in \bar{Q}. \quad (4)$$

When $k\sigma \leq 1$, from $f'(\xi) \leq 0$, we know that $-\Delta v = f(v) \geq f(u) = -\Delta u$, that is,

$$\begin{cases} \Delta(v - u) \leq 0, & x \in Q, \\ v - u = 0, & x \in \partial Q. \end{cases}$$

By the principle of extreme value, we know that $v \geq u$. This is in contradiction with u being the largest positive solution.

When $1 < k\sigma < 4 + 4\sigma$, we know that $f'(\xi) \geq 0$ when $0 \leq \xi \leq b$, and $f'(\xi) \leq 0$ when $b \leq \xi \leq \sigma$. Write

$$Q_1 = \{x \in Q \mid 0 \leq v(x) \leq b\}, \quad Q_2 = \{x \in Q \mid b \leq v(x) \leq \sigma\}.$$

Thus when $x \in Q_1$,

$$-\Delta v = f(v) \geq f(\alpha_0 u) \geq (\alpha_0 + \varepsilon_1)f(u) = -(\alpha_0 + \varepsilon_1)\Delta u,$$

and when $x \in Q_2$,

$$-\Delta v = f(v) \geq f(u) = -[\alpha_0 + (1 - \alpha_0)]\Delta u.$$

Let $\varepsilon = \min(\varepsilon_1, 1 - \alpha_0)$, then we have

$$\begin{cases} \Delta(v - (\alpha_0 + \varepsilon)u) \leq 0, & x \in Q, \\ v - (\alpha_0 + \varepsilon)u = 0, & x \in \partial Q. \end{cases}$$

By the principle of extreme value, we know that $v(x) \geq (\alpha_0 + \varepsilon)u(x)$, $\forall x \in Q$. This contradicts the definition for the number α_0 . The theorem is proved.

Theorem 1 proves that when $k\sigma < 4 + 4\sigma$, the problem has a unique positive solution. Then, what will it be when $k\sigma \geq 4 + 4\sigma$? The following Theorem 2 answers this question. To prove Theorem 2, we need the following introductory theorem [3]. Assume $\rho(x) > 0$ is continuous in Q , $\varphi(x) \in C^1(Q)$, and satisfies

$$\begin{cases} -\Delta\varphi(x) - \lambda\rho(x)\varphi(x) \geq 0, & x \in Q, \\ \varphi(x) = 0, & x \in \partial Q, \end{cases}$$

then $\varphi(x) \geq 0$, and only when $\lambda < u_1$, where u_1 is the first eigen value of

$$\begin{cases} -\Delta\phi(x) = \mu\rho(x)\phi(x), & x \in Q, \\ \phi(x) = 0, & x \in \partial Q \end{cases}$$

Theorem 2. Suppose $k\sigma \geq 4 + 4\sigma$, $\gamma < \lambda_1 \frac{k}{k+4+4\sigma} e^{\frac{k+2+2\sigma}{1+\sigma}}$, then problem (2) has a unique positive solution where λ_1 is the first eigen value of

$$\begin{cases} -\Delta\phi(x) = \lambda\phi(x), & x \in Q, \\ \phi(x) = 0, & x \in \partial Q \end{cases}$$

Proof: From $f(\xi) = \gamma(\sigma - \xi)e^{-\frac{\xi}{1+\xi}}$, we know

$$\begin{aligned} f'(\xi) &= \frac{\gamma}{(1+\xi)^2} [k(\sigma - \xi) - (1+\xi)^2] e^{-\frac{\xi}{1+\xi}}, \\ f''(\xi) &= -\frac{\gamma k}{(1+\xi)^3} [2 + 2\sigma - k\sigma + (2 + 2\sigma + k)\xi] e^{-\frac{\xi}{1+\xi}}. \end{aligned}$$

Because $k\sigma \geq 4 + 4\sigma$, thus $0 < \frac{k\sigma - 2 - 2\sigma}{k + 2 + 2\sigma} < \sigma$.

Therefore, when $0 \leq \xi \leq \sigma$, $f'(\xi)$ reaches the maximum value in $\xi_0 = \frac{k\sigma - 2 - 2\sigma}{k + 2 + 2\sigma}$, that is,

$$f'(\xi) \leq f'(\xi_0) = \frac{\gamma(k + 4 + 4\sigma)}{k} e^{-\frac{k+2+2\sigma}{1+\sigma}} = \gamma M.$$

Let $0 \leq \eta \leq \xi \leq \sigma$, then

$$f(\xi) - f(\eta) \leq \gamma M(\xi - \eta). \quad (5)$$

Suppose that the smallest positive solution of problem (2) is $z(x)$ [2]. If there is another positive solution $u(x)$, then $u(x) \geq z(x)$.

$$-\Delta(u - z) - \gamma M(u - z) = f(u) - f(z) - \gamma M(u - z) \leq 0.$$

Thus, by the introduction theorem, when $\gamma M < \lambda_1$, $u(x) \leq z(x)$, that is, when

$$\gamma < \lambda_1 M^{-1} = \lambda_1 \frac{k}{k+4+4\sigma} e^{\frac{k+2+2\sigma}{1+\sigma}}$$

then problem (2) has a unique positive solution.

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COMPUTER-AIDED OPTIMIZATION FOR EXISTING CHEMICAL PROCESSES

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[Text] Abstract: Using computer technology to improve the operation of the existing chemical processes will significantly raise the economic benefits of the chemical industry. Optimized operation of these processes can be attained through process simulation to find, with the aid of a computer and employing process optimization techniques, the optimal conditions for the process. In this article, an improved two-tier method, which is based on sequential quadratic programming, was described in which an extra parameter was introduced in the quadratic programming to construct a new quadratic programming problem. A decomposition strategy is presented which proves to be always feasible even when the decomposition matrix is singular. This new two-tier method gives better numerical stability and faster convergence. Satisfactory results were obtained when this algorithm was applied to optimize a methanol synthesis process and the results have been applied to the actual operation.

1. Introduction

In today's industrial chemical processes, the traditional fixed mode of operation faces increasing challenge. Early in the 1960's, Professor Box proposed the concept of EVOP[1] to improve the operational conditions of the existing chemical facility by the evolutionary approach to stepwise fine tuning. In the 1970's, Mezaki further developed the MEVOP[2]. This kind of flexible operation is now commonly called evolutionary operation (EVOP). The shift from fixed operation to flexible operation is an inevitable trend. We studied the application of the two-tier method to find the optimal operational conditions of a process. On the basis of literature reports[3,4], we proposed a new SQP algorithm that made the two-tier method more powerful by improving the decomposition strategy of the inner-loop algorithm and employing the watchdog technique. On this basis, we formulated a chemical process optimization simulation system CPOS01 and used a computer to implement

the algorithm. Using a methanol process as a case study, we investigated the simulated optimization of the total process, applied the results in actual plant operations, and obtained significant economic benefits. This work represents a beneficial step in moving the process optimization simulation technology from theoretical and applied research to actual industrial-scale applications and pushing the operation optimization of existing processes one step further from an individual unit toward the whole system.

II. Two-Tier Method

Definition: Process optimization nonlinear programming problem:

$$\begin{aligned} \text{(P0)} \quad & \min f(x) \\ & \text{s. t. } H(x, w) = 0 \\ & \quad c(x) = 0 \\ & \quad g(x) \geq 0 \end{aligned}$$

where w is the process parameter of individual process unit, x is the design parameter (or manipulated parameter), H is the process describing function, and c, g are design constraints.

The two-tier method, proposed by Jirapongphan^[4], used the simplification coefficient α and the simplified describing function $h(x, \alpha) = 0$, to simplify the problem as follows:

$$\begin{aligned} \text{(P1)} \quad & \min f(x) \\ & \text{s. t. } h(x, \alpha) = 0 \\ & \quad c(x) = 0 \\ & \quad g(x) \geq 0 \end{aligned}$$

This is called a nested loop algorithm problem and it is checked on the outer loop to see if it satisfies

$$\text{(P2)} \quad H(x, w) = 0$$

If not, the simplification coefficient α is recalculated and the inner-loop algorithm is repeated.

For the inner-loop algorithm problem, Jirapongphong adopted the decomposition method of Berna's^[3] and used the Han-Powell sequential quadratic programming method^[5] to solve the problem.

In applying the two-tier method, we found that it sometimes failed because the decomposition matrix was singular. We also found that the Han-Powell method did a line search at a slower rate and sometimes failed.

III. New Two-Tier Method

For convenience, the inner-loop algorithm problem is rewritten:

$$\begin{aligned}
 \text{(NLP)} \quad & \min_{x \in R^n} f(x) \\
 & \text{s. t. } h(x) = 0, \quad h: R^n \rightarrow R^m \\
 & \quad g(x) \geq 0, \quad g: R^n \rightarrow R^p
 \end{aligned}$$

Following the Han-Powell method, let $b = \nabla f(x)$, $J = \nabla h(x)$, $K = \nabla g(x)$, and an extra parameter that checks the linear constraints compatibility is introduced: $\bar{\xi} = (\bar{\xi}_1, \dots, \bar{\xi}_p)^T$. At each iteration, the following quadratic sub-program is solved for the search direction $\delta^{(k)}$, and the multipliers $\lambda^{(k)}$ and $\mu^{(k)}$:

$$\begin{aligned}
 \text{(QP)} \quad & \min \delta^{(k)T} b^{(k)} + \frac{1}{2} \delta^{(k)T} B^{(k)} \delta^{(k)} \\
 & \text{s. t. } J^{(k)} \delta^{(k)} + h^{(k)} \bar{\xi} = 0 \\
 & \quad K^{(k)} \delta^{(k)} + g^{(k)} \bar{\xi} \geq 0 \\
 & \quad 0 \leq \bar{\xi} \leq 1
 \end{aligned}$$

where

$$\bar{\xi}_j = \begin{cases} 1 & \text{when } g_j^{(k)} = g_j(x^{(k)}) > 0 \\ \xi & \text{when } g_j^{(k)} = g_j(x^{(k)}) \leq 0 \end{cases}$$

$$j = 1, \dots, p$$

For brevity, the superscript (k) will be omitted in the subsequent text.

Given the expanded matrix of J, $JH = [Jh]$. Let its dimension be r and $d = n - r + 1$. Choose from JHr independent columns to form a matrix JH^T and then choose from JH^T , the r independent rows to form a decomposition matrix JH_y^T and the remaining rows become a free matrix JH_u^T . Let's designate the rows in JH^T as $j^* = (j_1, \dots, j_{r-1}, j_r)$, in ascending order. Corresponding to such selections, the parameter $[\delta^T, \xi]^T$ is divided into two groups, one is the dependent parameter corresponding to JH_y^T and the other is the freed parameter corresponding to JH_u^T . Let $\delta_u = (\delta_{u_1}, \dots, \delta_{u_s})^T$, where

$$s = \begin{cases} d & \text{when } \xi \text{ is a dependent parameter} \\ d - 1 & \text{when } \xi \text{ is a freed parameter} \end{cases}$$

i.e., δ_u are the chosen freed parameters. An $s(n+1)$ -dimensional matrix $I_s = (e_{ij})$ is introduced to make $\delta_s = I_s \delta^T, \xi^T$. It is obvious that

$$e_{ij} = \begin{cases} 1 & \text{when } j \neq j^* \\ 0 & \text{when } j = j^* \end{cases} \quad i = 1, \dots, s$$

An auxiliary parameter $z = (z_1, \dots, z_s)^T$ and a constraint $\delta_u - z = 0$ are introduced to construct expanded quadratic subprogram

(EQP)

$$\begin{aligned} \min & \begin{pmatrix} b \\ -c \\ 0 \end{pmatrix}^T \begin{pmatrix} \delta \\ \xi \\ z \end{pmatrix} + \frac{1}{2} \begin{pmatrix} \delta \\ \xi \\ z \end{pmatrix}^T \begin{pmatrix} B & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} \delta \\ \xi \\ z \end{pmatrix} \\ \text{s. t.} & \begin{pmatrix} JH' & 0 \\ I_s & E_s \end{pmatrix} \begin{pmatrix} \delta \\ \xi \\ z \end{pmatrix} = 0 \\ & \begin{pmatrix} K & \xi & 0 \\ 0 & 1 & 0 \\ 0 & -1 & 0 \end{pmatrix} \begin{pmatrix} \delta \\ \xi \\ z \end{pmatrix} + \begin{pmatrix} \bar{\xi} & -\xi \\ 0 & 1 \end{pmatrix} > 0 \end{aligned}$$

to replace the original quadratic subprogram (PQP), where E_s is a s -dimensional unitary matrix and $\bar{\xi} = (\bar{\xi}_1, \dots, \bar{\xi}_s)^T$ in which

$$\bar{\xi}_i = \begin{cases} 0 & \text{when } g_i = g_i(x) > 0 \\ g_i & \text{when } g_i = g_i(x) \leq 0 \end{cases}$$

C is a large positive number that controls ξ to make it as close to 1 as possible.

Now let's consider the simplified decomposition of (EQP) under two different conditions:

1. When ξ is a freed parameter

Divide the parameter $(\delta^T, \xi, z^T)^T$ into dependent parameter $y = \delta$ and freed parameter $w = (\xi, z^T)^T$ and, at the same time, divide the Hessian matrix of (EQP) correspondingly

$$\left(\begin{array}{c|cc} B & 0 & 0 \\ \hline 0 & 0 & 0 \\ 0 & 0 & 0 \end{array} \right) = \left(\begin{array}{c|c} B_{yy} & B_{yw} \\ \hline B_{wy} & B_{ww} \end{array} \right)$$

Given $JH' = (J'K')$, and use I'_u to denote I_u with last row removed. Let

$$J_s = \begin{pmatrix} J' \\ I'_s \end{pmatrix}, \quad J_w = \begin{pmatrix} K' & 0 \\ 0 & -E_s \end{pmatrix} \quad (2.1)$$

it is not difficult to see that J_y is non-singular. Using the simplified decomposition equation in the literature[3], the following transformation matrix can be derived

$$A = J_y^{-1} J_w \quad (2.2)$$

and (EQP) can be reduced to quadratic program with respect to u

(REQP)

$$\min r'u + \frac{1}{2}u'Ru$$

$$\text{s. t. } Qu + q \geq 0$$

The simplified decomposition equations for r , R , Q , and q can also be derived:

$$R = A'B'A, \quad Q = K_+ - K_+A, \quad r = b_+ - A'b_+, \quad q = \begin{bmatrix} \bar{\xi} & -\xi \\ 0 & 1 \end{bmatrix} \quad (2.3)$$

where

$$K_+ = \begin{bmatrix} K \\ 0 \\ 0 \end{bmatrix}, \quad K_- = \begin{bmatrix} \bar{\xi} & 0 \\ 1 & 0 \\ -1 & 0 \end{bmatrix}, \quad b_+ = b, \quad b_- = \begin{bmatrix} -c \\ 0 \end{bmatrix}$$

2. When ξ is a dependent parameter

Let $y = (d', \xi)'$, $u = z$. The Hessian matrix of (EQP) is decomposed into

$$\left(\begin{array}{cc|c} B & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{array} \right) = \left(\begin{array}{c|c} B_{++} & B_{+-} \\ \hline B_{-+} & B_{--} \end{array} \right)$$

Given

$$J_+ = \begin{bmatrix} JH' \\ I_+ \end{bmatrix}, \quad J_- = \begin{bmatrix} 0 \\ -E_- \end{bmatrix} \quad (2.4)$$

then the equations for r , R , Q , and q in (REQP) can be derived as:

$$R = A' \begin{bmatrix} B & 0 \\ 0 & 0 \end{bmatrix} A, \quad Q = -K_+A, \quad r = -A'b_+, \quad q = \begin{bmatrix} \bar{\xi} & -\xi \\ 0 & 1 \end{bmatrix} \quad (2.5)$$

where

$$K_+ = \begin{bmatrix} K & \bar{\xi} \\ 0 & 1 \\ 0 & -1 \end{bmatrix}, \quad b_+ = \begin{bmatrix} b \\ c \end{bmatrix}$$

Solving the reduced quadratic program (REQP) for the best solution of u and the multiplier μ . Then the set of linear equations can be derived as follows:

(ELEP)

$$\begin{cases} y = -A. \\ J_y^T \lambda = B_{yy} y - K_y^T \mu + b_y \end{cases}$$

The multiplier λ can be solved. From these, the best solution of δ and multipliers λ and μ in (PQP) can be obtained.

It becomes obvious that by replacing (PQP) with the reduced quadratic program (REQP) and the linear equations (ELEP) to find the direction δ and multipliers λ and μ , the simplification greatly enhances the effectiveness of the Han-Powell algorithm because (REQP) is a $d = n - r + 1$ dimensional problem and the (PQP) is a n -dimensional one whereas the chemical process optimization problems often involve a large number of small degrees of freedom, i.e., $d \ll n$.

In the simplified decomposition, to get the transformation matrix A takes up a major portion of the calculations. The transformation matrix A and multiplier λ are calculated by solving the linear system

$$J_r A = J_r \quad (2.6)$$

Let

$$\sigma = \begin{pmatrix} 1 \cdots r & r+1 \cdots n+1 \\ i_1 \cdots i_r & j_1 \cdots j_r \end{pmatrix}$$

and do row substitution with σ in the matrix JH^r to get $(JH^r; JH^r)$, and do column substitutions with σ in A to get $(A^r; A^r)^T$, then equation (2.6) can be rewritten as

$$\begin{cases} JH^r; A_r = JH^r; \\ A_r = \begin{cases} [-E, 0] & \text{when } \xi \text{ is a freed parameter} \\ -E & \text{when } \xi \text{ is a dependent parameter} \end{cases} \end{cases} \quad (2.7)$$

in which JH_y^r is a r -dimensional reversible matrix, which is also sparse. And the equations for λ (ELEP) can be written as

$$JH_y^r \lambda = B_{yy}^r y - K_y^r \mu + b_y^r \quad (2.8)$$

where B_{yy}^r , K_y^r , b_y^r are the portions corresponding to JH_y^r after σ substitution of B_{yy} , K_y , b_y . Thus, LU decomposition can be applied to JH_y^r to solve (2.7) and (2.8) and the sparse matrix technique used to increase the speed and save storage space. In actual calculations, we first choose JH_y^r to determine the dependent parameters and the selection and decomposition of JH_y^r can be done simultaneously. Therefore, the selection does not increase the workload of calculations.

In the line search, we introduced the watchdog technique to raise the search efficiency. In modifying the original Hessian matrix B , we substituted it with the storage update vectors in order to save storage space and the (BFGS) equation was rewritten as

$$(VBFGS) \quad B^{k+1} = B^k + \sum_{j=1}^k (\bar{q}^j \bar{q}^j - \bar{B}^j \bar{B}^j)$$

in which

$$\bar{q}^j = q^j / \sqrt{\tau^j}, \quad \bar{B}^j = B^j q^j / \sqrt{\sigma^j}, \quad \tau^j = q^{jT} q^j, \quad \sigma^j = q^{jT} B^j q^j \\ (j=1, \dots, k)$$

η^1 is again calculated by using the Powell equation:

$$\bar{q}^j = \theta^j q^j + (1 - \theta^j) B^j q^j \\ \theta^j = \begin{cases} 1 & \text{when } \tau^j \geq 0.2\sigma^j \\ \frac{0.8\sigma^j}{\sigma^j - \tau^j} & \text{when } \tau^j < 0.2\sigma^j \end{cases} \\ \sigma^j = \nabla_x L(x^{j+1}, \lambda^j, \mu^j) - \nabla_x L(x^j, \lambda^j, \mu^j) \\ x^{j+1} = x^j + \sigma^j q^j \\ (j=1, \dots, k)$$

in which α^j is search step-length, and $L(x, \lambda, \mu)$ is a Lagrange function:

$$L(x, \lambda, \mu) = f(x) - \lambda^T h(x) - \mu^T g(x)$$

Set B^0 as a unitary matrix, and only updated vectors \bar{B}^j ($j=1, \dots, l$) are stored. The maximum number of iteration $l \ll n$ so there is a substantial saving in storage space when compared with the storage of B .

For clarity, the Han-Powell algorithm was served as the main framework (Method 1), which was then refined by the simplified decomposition method (Method 2) of quadratic subprogram and the watchdog technique of line search.

Method 1 (solving (NLP) with the Han-Powell algorithm)

1. $k = 0$. Given the initial value x^0 of (NLP), Hessian matrix B^0 , and other necessary initial values. Set line search marker as the standard line search mode: IDLS = 0.

2. Calculate the values of the following functions and the Jacobian matrix:

$$f(x^k), \quad h(x^k), \quad g(x^k), \quad b = \nabla f(x^k), \quad J = \nabla h(x^k), \quad K = \nabla g(x^k)$$

3. Solve the quadratic program (EQP) by applying the simplified decomposition method (Method 2) for the search direction δ^k and the multipliers λ^k, μ^k .

4. For a given convergence tolerance range c_{opt} , if $CONV < c_{opt}$, then accept x^k as the best solution. End.

$$CONV = |\nabla f(x^*)^T \delta^*| + |h(x^*)^T \lambda^*| + |G(x^*)^T \mu^*|$$

$$G(x) = (G_1(x), \dots, G_p(x))^T$$

$$G_j(x) = \min(0, g_j(x)), \quad j = 1, \dots, p$$

5. Do a line search in the direction δ^k by using the watchdog technique. Proceed to next point $x^{k+1} = x^k + \alpha^k \delta^k$. If a search fails, then interrupt.

6. Modify Hessian matrix B^k by using the (VBFGS) equation to get B^{k+1} . $k = k + 1$, go to 2°.

In the two-tier iteration, initially B^0 can be used as a unitary matrix. Later on, when re-entering the inner loop, B^0 can be treated as the B^k from the last inner-loop iterative convergence. This is continued until the Hessian matrix storage vectors are used up. Then set B^0 as the unitary matrix again. This kind of initial-value inheritance is helpful for convergence.

Method 2 (simplified decomposition method for quadratic subprogram)

1. Set expanded matrix $JH = (J \quad h)$ in which the decomposition matrix JH_y^T and freed matrix JH_u^T are chosen. Solve linear equations (2.7) for λ_y and λ_u , which constitute the transformation matrix A .

2. Calculate r , R , Q , and q in the reduced quadratic subprogram (REQP) by using the simplified decomposition equations (2.3) or (2.5).

3. Solve the reduced quadratic subprogram (REQP) for the best solution of u and the multiplier μ .

4. Calculate y from $y = -Au$. Solve linear equations (2.8) for the multiplier λ .

5. Solve $y = \delta$ or $(\delta^*, \xi)^T$ for δ , i.e., for the direction δ and the multipliers λ, μ on the iteration point x^k .

In step 4., any method appropriate for solving linearly constrained quadratic programming can be used. We employed the well-known Fletcher method [7]. Besides, the method used in solving the linear equations has a significant effect on the effectiveness of our method.

In carrying out our calculations, we confirmed the effectiveness of the watchdog technique [6] in accelerating the line search process and did not experience any failure.

IV.

We used the methanol facility of the Wujin Chemical Plant to study the simulated optimization of the whole process. The process of methanol synthesis is shown in Figure 1. We established altogether 73 simplified descriptive functions, which included 29 simplification coefficients, 20 inequalities for constraints, and 80 design parameters. The calculation results are shown in Table 3-1. The plant operation results are shown in Table 3-2. Without increasing the consumption of feedstock, fuel, and power, the production of methanol was increased by 1,032 tons within 6 months.

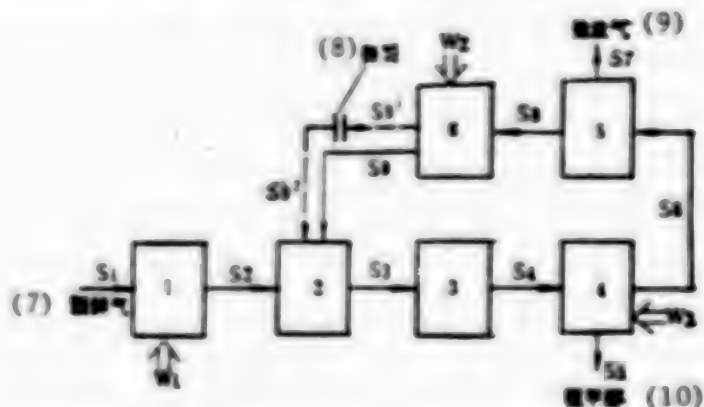


Figure 1. Flowsheet Diagram of Methanol Synthesis Process

Set of shear flow = {S9}

Calculation sequence = (1, 2, 3, 4, 5, 6)

W1, W2, W3--energy consumption in the objective function

Key:

1. High-pressure generator
2. Gas mixer
3. Reactor
4. Condensor
5. Material flow split
6. Cyclic compressor
7. Fresh input gas
8. Shear
9. Released gas
10. Crude methanol

Table 3-1. Calculation Results of the Operation Optimization

Decision parameters	Initial values	Optimization results
Methane content in the fresh input gas	0.04814	0.03694
$\frac{H_2-CO_2}{CO+CO_2}$ (fresh input gas)	2.01	2.13
Methane content in the inlet gas	0.3436	0.2845
$\frac{H_2-CO_2}{CO+CO_2}$ (inlet gas)	8.387	4.725
Synthesis pressure	279.0	260.0
Fraction purged	0.036	0.0155
Cooling temperature of the condenser (°C)	15.0	28.7
Values of the objective function (Kcal/ton of crude methanol)	1.623×10^6	1.442×10^6

The values obtained at the intermediate period of the operation in which a catalyst was in use were used for the relevant parameters in the calculations. The operation was based on the results of optimization calculations but modifications were made on some parameters taking into consideration the various stages of the catalyst usage and the constraints of safe production.

Table 3-2. Plant Operation Results

(2) 时 间 (1) ($\times 10^4$ 千 (吨甲醇))	调 优 前 (5)		调 优 后 (6)	
	1982年	1983年	(7) 1984年1—10月	(8) 1984年1—4月, 9—10月
(3) 总 能 耗 (原料油耗 + 燃料油耗 + 电耗)	11.23	11.14	11.043	10.932
(4) 总能耗下降 (与1982年相比)	0	0.09	0.187	0.298

All are average values.

Data are not shown for the period of May-August 1984 because of irregular production caused by equipment, feedstock supply, and public utility problems.

Key:

1. Time
2. Energy consumption ($\times 10^6$ Kcal/ton methanol)
3. Total energy consumption (feedstock + fuel + electricity)
4. Total energy saving (compared with 1982)
5. Before optimization
6. After optimization
7. January-October 1984
8. January-April, September-October 1984

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12922/6091

CSO: 4008/1047

Z80 EPROM PROGRAMMING ON APPLE II PLUS

Beijing WEIJISUANJI YINGYONG [MICROCOMPUTER APPLICATIONS] in Chinese Vol 7,
No 2, Mar 86 pp 68-70

[Article by Chu Xiaohua [2806 2556 5478] and Sun Zubao [1327 4371 1405],
Department of Precision Instruments, Tianjin University: "Writing Z80 Assembly
Language Files into EPROMs on the DJS-033 (Apple II Plus)"]

[Text] The Apple II Plus is a microcomputer with a 6502 microprocessor as its CPU. Its primary characteristics are that the hardware and software of this machine are all modular, and the intelligence of its interface boards allow flexible configurations, with convenient expansion. Expansion can be realized when configured with different peripheral equipment cards. For example, after inserting the SoftCard (or Z80 card), with the support of a language card and under management of the CP/M operating system, COBOL, FORTRAN, and BASIC compilers and assembly language development systems can be added, allowing programs written for the Z80 and 8080A to be run on the Apple. In addition, with the Apple II one can also install an EPROM programmer, can copy ROM, can edit ROM, and can store the contents of ROM onto a floppy disk (or also on cartridge tape).

We know from this that the Apple II Plus is quite convenient for single-board computer software development and debugging. Consequently, where it is deficient is that the EPROM programmer used in the Apple II operates under the Apple II disk operating system (DOS).

The fundamental concept of this paper is that by using an alternate operating system for the computer, this allows the user to edit the EPROM when the contents of RAM are unchanging. Therefore, to use the current hardware and software, we must establish a mutual conversion between the DOS and CP/M operating systems. This only requires placing a CP/M system disk into the disk drive, [keying in] PR#X (where X is the number of the peripheral slot for the driver) or key in XCTRL-P (the monitor program). Because there is no cold boot command for the CP/M system, it was necessary to write a BOOT.COM file (the program listing for which is appended), allowing initialization of the disk driver and to accomplish the conversion from the CP/M operating system to the other operating system.

We give below an example to show how to use existing software and hardware to program EPROMs. In the procedure given below, aside from the host machine, the display device, and the disk driver hardware, it is also necessary to have an EPROM programmer (we use the FP-64 EPROM WRITE), a language card, and the Z80 card. One DOS working disk is required and one CP/M disk. The following files should be on the CP/M disk:

EX.COM DEBUG.COM BOOT.COM

Naturally, the file that is to be written should also be there (the file here is SEM.HEX, starting address for which is 800H), which is created by a Z80 assembly language program, after assembly of which one gets the Z80 machine language program.

We will now write the SEM.HEX file into a 2716 EPROM, which is done like so:

The 2716 EPROM is put into the EPROM programmer, then the EPROM programmer is placed into any position from slot 1 to slot 7 (here we will use No 4).

Put the CP/M disk into drive A, turn on the host power, and at this time operation will be under the CP/M operating system.

The CRT will display

```
APPLE II CP/M          (C) 1980 MICROSOFT
56K VER 2.20           A>
```

Key in EX DEBUG, press the carriage return (RETURN); the CRT will display:

```
MICAH CP/M EXPANDER VERSION 5.1  DEBUG VERSION 00.17
```

Key in FSEM.HEX, then press the carriage return; key in R1800, hit the carriage return (the shift amount 1800 is to place SEM.HEX at 2000H for its starting address in RAM) (the file SEM.HEX is 7ABH long), the CRT displaying:

```
NEXT=27AB              NEXTM=27AB
```

Key in FBOOT.COM, press the carriage return, key in R, press the carriage return, and the CRT will display:

```
NEXT=27AB              NEXTM=010F
```

Key in G, press the carriage return, which makes the CP/M disk get F, transfer it to the DOS working disk, press the carriage return and the CRT will display:

```
]      (i.e., the computer has switched to the DOS operating system)
```

Key in PR#4, press the carriage return and CRT will display:

```
TFK 64 AP TASKPORTS/KOCHI V5.0      ROM SIZE?
COPYRIGHT BY MAEDA & SEGEAWA
```

Key in 2 (because the EPROM to be programmed is a 2716) and the CRT will display:

- | | |
|----------|---------|
| 1) WRITE | 3) COPY |
| 2) READ | 4) MON |

Key in 1, and the CRT will display:

ROM CHECK OK! START ADDRESS? \$

Key in 3000, press the carriage return (because the difference between the addresses used by the 6502 CPU and those used by the Z80 CPU is 1000H); the CRT will display:

SW ON

Turn on the switch at the rear of the EPROM programmer, and when the light goes on press the carriage return and the CRT will display:

WRITE X X X X

The computer will count from 0000 - 07FF, and when the counter value is 07FF, the CRT will display:

VERIFY OK! SW OFF

Turn off the switch at the rear of the EPROM programmer, and when the light is extinguished press the carriage return and the CRT will display:

- | | |
|----------|---------|
| 1) WRITE | 3) COPY |
| 2) READ | 4) MON |

At this point, the entire writing process has been completed.

If you read the contents of the EPROM and debug it with Z80 assembly language, you may proceed with the following steps:

Place the EPROM (say, a 2716) into the EPROM programmer, then insert the EPROM programmer into its corresponding peripheral slot (say, No 4), and upon initiation when the DOS operating system has installed its drivers, the CRT will display:

]

Key in PR#4, press the carriage return and the CRT will display:

TFK 64 AP TASKFORTS/KOCHI V5.0	ROM SIZE?
COPYRIGHT BY MAEDA & SEGEAWA	

Key in 2 (the EPROM is a 2716) and the CRT will display:

- | | |
|----------|---------|
| 1) WRITE | 3) COPY |
| 2) READ | 4) MON |

Key in 2, and the CRT will display:

START ADDRESS? \$

Key in 2000, press carriage return and CRT will display:

READ

- | | |
|----------|---------|
| 1) WRITE | 3) COPY |
| 2) READ | 4) MON |

Key in 4 and CRT will display:

*

Key in 2000, look at the contents of the EPROM, insert the CP/M disk into drive A:, then key in 6 CTRL-P and carriage return, when CRT will display:

APPLE II CP/M	(C) MICROSOFT
56K VER 2.20	A>

Key in SAVE 30 D.COM, key in EX DEBUG and press the carriage return, when CRT will display:

MICAH CP/M EXPANDER VERSION 5.1 DEBUG VERSION 00.17

Key in FD.COM, key in R, and CRT will display:

NEXT=1F00 NEXTM=1F00

Here, you have entered the Z80 debugging program and you may begin debugging. When all work is finished, write it back into the EPROM, and finally take out the EPROM and place it into a single board computer for use. This is how to do debugging for a Z80 single-board computer.

By using this method, not only may you write the contents using a Z80 assembly language file, but you can also write any files running under CP/M, such as COBOL, BASIC, FORTRAN, and 8080 assembler, into EPROMS for use on other machines. Files managed under other operating systems may also be converted to the DOS operating system for writing or reading.

Appendix: BOOT.COM program listing

BDOS:	EQU	0005H	;STANDARD CP/M ENTRY
CONIN:	EQU	1	;CONSOLE INPUT FUNCTION
Z\$CPU:	EQU	0F3DEH	;LOCATION OF SOFTCARD STORED HERE
A\$VEC:	EQU	0F3DOH	;ADDR. OF 6502 SUB TO CALL GOES HERE
ADB:	EQU	0C600H	;APPLE DISKETTE BOOT ROUTINE

ORG	100H	
LD	C,CONIN	;READ NEXT CHARACTER
CALL	BDOS	;RETURN
LD	HL,ADB	;GET ADDRESS OF SUBROUTINE
LD	(A\$VEC),HL	;STORE IT FOR 6502 CALLER
LD	HL,(Z\$CPU)	;GET SOFTCARD ADDRESS
LD	(HL),A	;GO DO IT!
END		

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CSO: 4008/1020

DETERMINATION OF COPOLYMERIZATION PARAMETERS OF TRIBUTYLTIN METHACRYLATE WITH METHYL METHACRYLATE BY FTIR

Lanzhou HECHENG XIANGJIAO GONGYE [SYNTHETIC RUBBER INDUSTRY] in Chinese
Vol 9 No 2, Mar 86 pp 111-115

[English abstract of article by Han Zhewen [7281 0772 2429] of the Department of Applied Chemistry, University of Science and Technology of China, Hefei; Yu Zhuqing [0151 4554 0615], et al., of the Department of Chemistry, University of Anhui, Hefei]

[Text] Organotin copolymers have been shown to possess biocidal activities, such as antibacterial, antifungal and antifouling properties, and structural properties which are similar to those of ordinary organic polymeric materials. In the present work, the copolymer compositions of tributyltin methacrylate (TBTM) with methyl methacrylate (MMA) were measured by Fourier transform infrared (FTIR) spectroscopy conveniently and rapidly. The monomer reactivity ratios for radical copolymerization of TBTM with MMA at 60°C in xylene solution were calculated to be $r_1 = 0.62$ and $r_2 = 0.58$, respectively. Also, the solubility and thermal properties of TBTM-MMA copolymers were studied. (Paper received 21 Jul 85.)

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CSO: 4009/1075

CALCULATING NON-NEWTONIAN FLOW INDEX OF RUBBER COMPOUNDS WITH MICROCOMPUTER

Lanzhou HECHENG XIANGJIAO GONGYE [SYNTHETIC RUBBER INDUSTRY] in Chinese
Vol 9 No 2, Mar 86 pp 120-124

[English abstract of article by Qiu Hong [6726 1347], et al., of the Department of Polymer Science, Beijing Institute of Chemical Technology]

[Text] The Apple-II microcomputer was used for regression analysis of the given mathematical model, $\lg \dot{\gamma}_w = c + a(\lg \dot{\gamma}_w)^b$, which was adopted for describing the flow curves of a SBR/CaCO₃ filler loaded system, as well as for calculation of the non-Newtonian flow index of rubber compounds. The calculated results of flow indexes showed that the method of linear regression was preferable to methods of nonlinear regression in the solution of nonlinear equations.

(Paper received 15 Jun 85.)

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CSO: 4009/1075

NEW OPTIMUM SYNTHESIS METHOD IN DESIGNING PLANAR MECHANISMS

Chongqing CHONGQING DAXUE XUEBAO [JOURNAL OF CHONGQING UNIVERSITY] in Chinese
Vol 9 No 3, Sep 86 pp 19-26

[English abstract of article by Long Yukuang P7893 1342 0342], et al., of the
Department of Mechanical Engineering]

[Text] A new synthesis method, the "Least Center of Circle Error Method," is presented. For a four-bar linkage mechanism, the optimum synthesis is carried out in two steps and a total of nine unknown parameters is obtained, which is the so-called "All Parameters Optimum Synthesis." For a six-bar linkage mechanism, 13 optimum unknown parameters can be obtained. With this method there is no longer any need to solve non-linear equations and also no need to use the conventional optimum program. It is also noticed that the number of design points does not have to be limited and no initial guess of unknown parameters is needed. The time consumed by computing is so small that it is suitable for computing in microcomputers. Several universal-purpose micro-examples are given. (Paper received 3 Mar 86.)

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CSO: 4009/1088

METHOD OF SHAPE OPTIMIZATION IN ELASTIC CONTACT PROBLEM OF MACHINE PARTS AND STRUCTURES

Chongqing CHONGQING DAXUE XUEBAO [JOURNAL OF CHONGQING UNIVERSITY] in Chinese Vol 9 No 3, Sep 86 pp 27-36

[English abstract of article by Liu Chongde [0491 1504 1795], et al., of the Department of Mechanical Engineering]

[Text] A numerical method is presented for shape optimization in the elastic contact problem by combining the Finite Element Method and shape optimization of a continuing body. Using the previous method the authors successfully analyze and design a new flange closure for crude petroleum pipelines. The authors describe the algorithm method in detail and give results of the optimum design of the closure. (Paper received 22 Feb 86.)

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CSO: 4009/1088

IMPROVED HIGH-ORDER FINITE ELEMENT METHOD FOR AXISYMMETRIC FIELD COMPUTATION

Chongqing CHONGQING DAXUE XUEBAO [JOURNAL OF CHONGQING UNIVERSITY] in Chinese
Vol 9 No 3, Sep 86 pp 45-53

[English abstract of article by Chen Ruimin [7115 6904 2404], et al., of the
Department of Electrical Engineering]

[Text] An improved high-order finite element method is presented to calculate axisymmetric field problems. Both exact and numerical integrals are introduced into the element analysis, which not only overcomes the difficulties caused by improper integrals near the axis, but also reduces the computing time. This high-order finite element method, compared with the first-order method, has higher accuracy and lower cost for axisymmetric field problems. Moreover, the errors that tend to increase near the axis, still remaining in other methods, can be reduced. (Paper received 7 Jan 86.)

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CSO: 4009/1088

EXTENDING MINIMUM-VARIANCE SELF-TUNING CONTROLLER

Chongqing CHONGQING DAXUE XUEBAO [JOURNAL OF CHONGQING UNIVERSITY] in Chinese
Vol 9 No 3, Sep 86 pp 54-62

[English abstract of article by Wang Yong [3769 0516], et al., of the Department of Automation]

[Text] A new self-tuning control algorithm is proposed. It restrains the varying rate of the system output, and provides steady control to the nonminimum-phase system, when proper parameters are chosen. The performance of the control system can be adjusted easily. This algorithm satisfies the closed-loop identification condition and gives high control precision to the system. All parameters involving θ_0 are directly estimated on line. A simple method to reduce the steady state error is pointed out. All of the above are proved by simulation and real-time control. (Paper received 8 Jan 86.)

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CSO: 4009/1088

MORPHOLOGY EVOLUTION OF BAINITIC FERRITE IN LOW CARBON Fe-C-Mo ALLOYS AND PROBLEM OF GRANULAR BAINITE

Chongqing CHONGQING DAXUE XUEBAO [JOURNAL OF CHONGQING UNIVERSITY] in Chinese Vol 9 No 3, Sep 86 pp 98-106

[English abstract of article by Xu Qikun [1776 0796 2492] of the Department of Metallurgy and Materials Engineering]

[Text] A tracked sampled investigation is presented metallographically on the process of the morphological evolution of bainitic ferrite from degenerate to blocky or platy during intermediate transformation. It is proved that the so-called granular bainite microstructure is nothing but the structural characteristic at a certain stage in its evolution. A suggestion is offered to classify the bainite structures morphologically into "low carbon bainite" and "high carbon bainite." (Paper received 14 Apr 86.)

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CSO: 4009/1088

DYNAMICS OF FORMATION OF ZIGZAG GRAIN BOUNDARIES IN GH49 ALLOY

Chongqing CHONGQING DAXUE XUEBAO [JOURNAL OF CHONGQING UNIVERSITY] in Chinese
Vol 9 No 3, Sep 86 pp 107-115

[English abstract of article by Wang Yueyi [3269 2574 3015], et al., of Yindu Machinery Plant; Zhang Yaping [1728 0068 1627] of Chongqing University]

[Text] The dynamics of the formation of zigzag grain boundaries obtained through isothermal heat treatment of the GH49 alloy have been studied. It is shown that the dynamic curve of the zigzag grain boundary starting grain formation is similar to a "C" shape, and the effectiveness for obtaining zigzag grain boundaries is best when the isothermal treatment temperature chosen is at the "nose" temperature, which is 1070°C in the "C" curve of this alloy. Metallographic investigation indicates that the formation of zigzag grain boundaries is related to the precipitation of γ' phases and carbides on grain boundaries. A regression treatment has been employed to form the expression between the percent of zigzag grain boundaries and the number of precipitate particles. (Paper received 7 Jan 86.)

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ANALYSIS OF TRANSIENT RESPONSE BY TRANSFER SUBSTRUCTURE METHOD

Chongqing CHONGQING DAXUE XUEBAO [JOURNAL OF CHONGQING UNIVERSITY] in Chinese
Vol 9 No 3, Sep 86 pp 139-148

[English abstract of article by Zhu Tianguo [2612 1131 0948] of the Department of Engineering Mechanics]

[Text] The transfer substructure method is developed, and applied to analyze the transient response of structures, and a new algorithm is established for solving the structural dynamic response. The basic principle of this new algorithm is presented in detail and its calculating formulas are derived. Thus, a BASIC program on a microcomputer is designed. The accuracy and efficacy of this method are proved by means of several actual examples. (Paper received 26 Feb 86.)

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CED: 4009/1088

ANALYSIS OF STABILITY OF FLYBACK SWITCHING-MODE REGULATOR

Beijing QINGHUA DAXUE XUEBAO (ZIRAN KEXUE BAN) [JOURNAL OF TSINGHUA UNIVERSITY (NATURAL SCIENCE)] in Chinese Vol 26 No 5, Oct 86 pp 1-9

[English abstract of article by Cai Xuansan [5591 1357 0005], et al., of the Department of Electrical Engineering]

[Text] In this paper the open loop transfer function of the flyback switching mode regulator (FSMR) is derived by using the state-space averaging approach. An illustrative example is given for computing the Bode plot of FSMR. The impact of DC duty ratio on the Bode plot and system stability of FSMR, compared with the forward switching system, is also given. (Paper received April 1985.)

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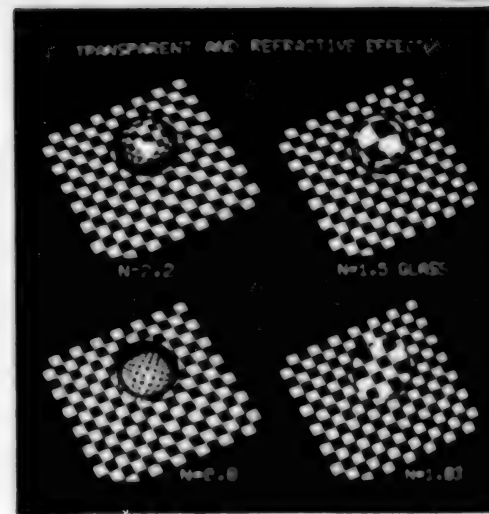
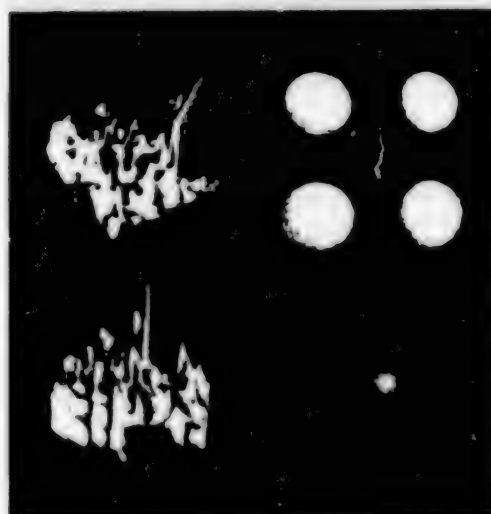
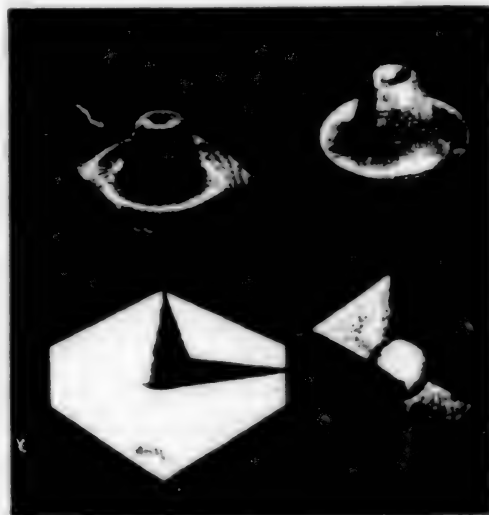
CSO: 4009/1082

GENERATION AND DISPLAY OF REALISTIC THREE-DIMENSIONAL COMPUTER GRAPHICS

Beijing QINGHUA DAXUE XUEBAO (ZIRAN KEXUE BAN) [JOURNAL OF TSINGHUA UNIVERSITY (NATURAL SCIENCE)] in Chinese Vol 26 No 5, Oct 86 pp 10-21

[English abstract of article by Li Shuliang [2621 0647 2733], et al., of the Department of Radio Electronics]

[Text] In this paper, the methods for generating and displaying realistic three-dimensional computer graphics, such as geometrical transformation, hidden surface removal, shading and texturing, are studied. An improved scan line method for generating and displaying realistic three-dimensional graphics is presented. Its advantages are less memory space required and higher speed of operation. In the shading model, the reflective, transparent, refractive and shadow effects are considered. A stochastic model is used to generate surface texture. Finally, a method for producing a three-dimensional terrain map is proposed.



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CSO; 4009/1082

LOOP ANALYSIS OF GENERALIZED NETWORK FLOWS IN ELECTRIC POWER SYSTEMS OF CALCULATIONS WITH ON-LINE APPLICATIONS. II. APPLICATIONS TO ON-LINE LOAD FLOW CALCULATIONS

Beijing QINGHUA DAXUE XUEBAO (ZIRAN KEXUE BAN) [JOURNAL OF TSINGHUA UNIVERSITY (NATURAL SCIENCE)] in Chinese Vol 26 No 5, Oct 86 pp 22-32

[English abstract of article by Zhang Boming [1728 0130 2494], et al., of the Department of Electrical Engineering, Qinghua University; Yu Erkeng [0060 1422 6972] of the Power System Control Department, EPRI]

[Text] The basic concepts of the generalized network and flow and an approach showing how to solve them were presented in the first part of the paper. Applications of the theory and approach to on-line load flow calculations of electric power systems are dealt in this part of the paper. A fast load flow method is obtained. Numerical results obtained by the proposed method and those obtained by conventional methods are given for comparison. (Paper received July 1985.)

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CSO: 4009/1082

LOGIC PARTITIONING FOR MULTITERMINAL NETWORK MODEL

Beijing QINGHUA DAXUE XUEBAO (ZIRAN KEXUE BAN) [JOURNAL OF TSINGHUA UNIVERSITY (NATURAL SCIENCE)] in Chinese Vol 26 No 5, Oct 86 pp 33-43

[English abstract of article by Hou Zifeng [0186 4793 1496], et al., of the Department of Computer Science and Engineering]

[Text] In this paper, a multiterminal network model is presented. The model is adequate for partitioning real circuits. Under this model, a pair interchanging gain formula for the cost between two subsets is presented, and a single-side shift gain formula and a pair interchanging gain formula for the external cost of a subset are given. An algorithm in which the single-side shift method is combined with the pair interchanging method is suggested for two-way improved iterative partitioning. Finally, some experimental results are given. (Paper received February 1985.)

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CSO: 4009/1082

CROSSTALK ANALYSIS OF TOTAL-INTERNAL-REFLECTION SWITCHES

Beijing QINGHUA DAXUE XUEBAO (ZIRAN KEXUE BAN) [JOURNAL OF TSINGHUA UNIVERSITY (NATURAL SCIENCE)] in Chinese Vol 26 No 5, Oct 86 pp 60-67

[English abstract of article by Sun Weimin [1327 5898 3046], et al., of the Department of Radio Electronics]

[Text] This paper analyzes several factors which affect the improvement in crosstalk of total-internal-reflection (TIR) switches. When the switch efficiency is high, barrier leakage, widening of beamwidth and coupling between optical waveguides may be the main factors that worsen the crosstalk, depending on the light wavelength and waveguide dimensions. Some curves are also given which are suitable for the design of TIR switches. (Paper received April 1985.)

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CSO: 4009/1082

SLIP-LINE FIELD PROBLEMS SOLVED BY METHOD OF APPROACH

Beijing QINGHUA DAXUE XUEBAO (ZIRAN KEXUE BAN) [JOURNAL OF TSINGHUA UNIVERSITY (NATURAL SCIENCE)] in Chinese Vol 26 No 5, Oct 86 pp 68-83

[English abstract of article by Hu Zhong [5170 1813], et al., of the Department of Mechanical Engineering]

[Text] A method of approach and computer-aided calculation were developed to solve a slip-line field with a node falling at the required position and with coulombial frictional boundary conditions in the compression and wedge die extrusion. Slip-line field meshes were plotted with high accuracy. (Paper received September 1985.)

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CSO: 4009/1082

TECHNICAL DEVELOPMENT OF THERMOPLASTIC ELASTOMER OF STYRENE-BUTADIENE-STYRENE.
IV. TRIAL PRODUCTION IN COMMERCIAL PLANT

Lanzhou HECHENG XIANGJIAO GONGYE [SYNTHETIC RUBBER INDUSTRY] in Chinese
Vol 9 No 6, Nov 86 pp 379-383

[English abstract of article by Wang Xingya [3769 5281 0068], et al., of the Chemical Engineering Research Institute, Lanzhou Chemical Industry Corporation; Han Dagui [7281 1129 6311], et al., of the Synthetic Rubber Factory, Lanzhou Chemical Industry Corporation]

[Text] Trial production of a radial styrene-butadiene block copolymer was carried out in 2,000 t/a solution polymerization plant using anionic polymerization technology with sec-butyllithium as initiator and cyclohexane as diluent, and by subsequent coupling reaction with silicon tetrachloride as coupling agent. The polymer solution was steam-stripped and the wet rubber crumb was squeezed and dried to a water content of about 0.7 percent by weight through a single screw extruder with a heating device. The extruder was fed continuously at a throughput of 300 kg/h. The mechanical properties of the final product are equivalent to those products previously obtained at a pilot plant. (Paper received 4 Aug 86.)

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CSO: 4009/1074

SYNTHESIS OF NOVEL SILICONE RUBBER WITH N,N-BISALLYL- γ -AMINOPROPYL SIDE CHAINS

Lanzhou HECHENG XIANGJIAO GONGYE [SYNTHETIC RUBBER INDUSTRY] in Chinese
Vol 9 No 6, Nov 86 pp 388-392

[English abstract of article by Du Zuodong [2629 0155 2767], et al., of the Chemistry Department, Shandong University, Jinan]

[Text] A novel silicone rubber, polysiloxane, containing N,N-bisallyl- γ -aminopropyl side chains, has been synthesized. This silicone rubber can be cured with peroxide or Pt-catalyst in the presence of Si-H bond containing substances, and the vulcanizates show high tensile strength and elongation. In addition, this silicone rubber possess the characteristic feature of auto-vulcanization, and it is also vulcanizable via salt-formation with organodihalides. (Paper received 30 Apr 86.)

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CSO: 4009/1074

STUDY OF MICROKINETICS OF BUTADIENE POLYMERIZATION WITH $\text{MoCl}_5-(i\text{-Bu})_2\text{AlO}-\text{CH}_2$ CATALYST. II. MOLECULAR WEIGHT AND CHAIN TRANSFER REACTION

Lanzhou HECHENG XIANGJIAO GONGYE [SYNTHETIC RUBBER INDUSTRY] in Chinese Vol 9 No 6, Nov 86 pp 403-407

[English abstract of article by Yang Yuwei [2799 3768 0251], et al., of the Department of Polymer Engineering, Qingdao College of Chemical Technology]

[Text] The microkinetics and chain transfer reactions of butadiene polymerization by $\text{MoCl}_5-(i\text{-Bu})_2\text{AlO}-\text{CH}_2$ catalyst have been studied, and the rate constants of the chain transfer reactions to the monomer, catalyst and cocatalyst have been determined. The experimental results show that the molecular weight of the polymer obtained increases with the increase in polymerization time, the rate of the chain transfer reaction increases with an increase in polymerization temperature, and the catalyst MoCl_5 is the main chain transfer agent. (Paper received 10 Oct 85.) (Pt. I: See JPRS-CST-86-033, 18 Aug 86)

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CSO: 4009/1074

ULTRAMICROSCOPIC OBSERVATIONS ON THE PROTECTIVE EFFECT OF CHINESE HERB HUANGQI (*Astragalus membranaceus*) ON BEATING RAT MYOCARDIAL CELLS INFECTED BY COXSACKIE B-2 VIRUS

Shanghai XIBAO SHENGWUXUE ZAZHI [CHINESE JOURNAL OF CELL BIOLOGY] in Chinese Vol 8, No 2, Jun 86 pp 87-88

[Article by Shen Juying [3088 5468 5391] and Gong Zuxun [7895 4371 1053], both of Shanghai Institute of Biochemistry, Academia Sinica, and Yang Yingzhen [2799 5391 3791], Guo Qi [6753 2759], Jin Peiyong [6855 0160 5391], Yang Xueyi [2799 1331 5030], Pu Shouyue [3184 1108 2588], and Chen Haozhu [7115 3493 3796], all of Shanghai Municipal Institute of Cardiovascular Studies and Zhongshan Hospital of Shanghai Medical University]

[Text] A previous article had reported on our use of the electron microscope to observe pulsating myocardial cells of newborn rats infected by Coxsackie B-2 virus. The cell ultramicroscopic structure showed obvious pathological changes, and use of the Chinese herb Huangqi (*Astragalus membranaceus*) demonstrated a protective effect on the release of myocardial enzymes lactic dehydrogenase and glutamic oxalacetic transaminase, and stoppage of cell pulsation etc., the data on which will be published later. Based on observations of the ultramicroscopic structural changes, the cell pathology and cell pulsation noted under a phase-difference microscope, this article reports on the protective effect of Huangqi on cultured beating rat myocardial cells infected by Coxsackie virus B-2, and provides certain data for preventing and treating acute viral myocarditis clinically.

Materials and Methodology

1. Myocardial Cells and Virus

The hearts of newborn Sprague-Dawley rats (1-4 days old) are taken and treated with 0.1 percent trypsin (Difco 1:250) solution to digest the cells in separate batches. Preparation of the cells has been described in a previous article [2]. For the growth medium, we use MEM Eagle's solution containing 20 percent bovine serum, 1 percent glutamine, and a double antibiotic (penicillin 200 microgm/ml, streptomycin 100 microgm/ml). Titration of Coxsackie B-2 virus (ATCC VR29) and 50 percent tissue infectivity (TCID-50) follows that described previously [1]. Huangqi injection solution (4g/2ml 840308) is supplied by the Chinese Herb Pharmacy of Huashan Hospital, Shanghai Medical University.

2. Examination by Inverted Phase-Difference Microscope

Classification of cell suspensions after digestion follows that previously described [1]. To each jar containing 4×10^6 cells, a growth stimulating solution is added for a total volume of 5 ml. After incubation at 37°C for 48 hours, this fluid is discarded. For the 6 jars in the infected group, 1 ml of growth stimulating solution, which also contains 50 TCID-50 Coxsackie virus B-2 is added to each jar. For the 6 jars in the uninfected (control) group 1 ml of growth stimulating solution only, is added to each jar. Jars are then incubated for another hour at 37°C, after which huangqi is added to 3 jars from each group (4.5 g/jar), and labeled the huangqi control and the infected huangqi groups. Finally, growth stimulating solution is added, to each jar for a total volume of 5 ml. Jars are then placed under an inverted phase-difference microscope daily for observation of pulsating conditions and cell pathology.

3. Examination by Electron Microscope

After the four groups described above (cell control, huangqi control, infected, and infected huangqi) have been cultured for 2, 4, and 6 days after virus infection, one jar is taken from each group to undergo two washings in Hank's solution that contains no calcium or magnesium ions. After this, cells are fixed by 2 percent glutaric dialdehyde 0.1M, pH 7.2 phosphoric acid buffer for 3 to 4 hours. Then a stainless steel spoon is used to scrape off cells stuck to sides of their culture flasks, and contents are centrifuged at 3,000 rpm for 20 minutes, then kept at 4°C. The electron microscope protocol also follows that previously described [1]. Samples are examined under a Hitachi H-300 electron microscope.

Results

1. Cell Pulsation and Cell Pathology

The day after virus inoculation, the infected cells as seen under the inverted microscope were still beating, though more slowly and irregularly, with no obvious pathological changes noted. On the 4th day post-infection, the myocardial cells had stopped beating, and pathological changes such as cells rounding off, clumping and shrinking, were evident. At the same time, the endothelial-like cells had also stopped growing, though no obvious cellular abnormality was noted. On the 6th day post-infection, pathological changes in cells of the infected group became increasingly marked, but cells in the cell control group, the huangqi control group, and the infected huangqi group were still beating regularly and forcefully at 80-100 beats/minute, and no cell pathology similar to that in the infected group was noted. This experiment was performed four times.

Ultramicroscopic Structural Changes

After the cultured pulsating rat myocardial cells had been infected by Coxsackie B-2 virus, a series of cell changes on the ultrastructural level took place, becoming more marked as the duration of infection became more prolonged. On the 2nd day post-infection, cell nucleus aberrations and

swollen mitochondria appeared, the intercalary disks showing varying degrees of separation [Figure 1]. When cell pulsation tended toward stoppage during the late stage of pathological changes (4th day), the myofibrils became disorganized and crossed, showing likely breaks locally. On the 6th day post-infection, viral fragments in a crystalline square pattern appeared, and characteristic inclusion bodies were seen within the infected cells (Figure 2), which explained the fact that large numbers of virus progeny have been replicated. As seen under the inverted phase-difference microscope at this time, the myocardial cells showed increasingly greater pathological changes, the beating stopped, and the cells veered close to death.

In the group of infected cells to which huangqi had been added, a sampling taken after 2 days and compared with those from the infected group showed disappearance of the intercalated disk separation phenomenon, appearance of folds in the cell nuclei, an abundance of glycogen granules, a dense packing of the mitochondria in the concentric pattern occasionally seen in mitochondria of normal myocardial cells, and the myofibrils maintaining their neat orderly appearance. After 4 days, the cell nuclei showed no obvious pathological change and the myofibrils still maintained an orderly pattern (Figure 3). These results are basically in agreement with the macroscopic cell findings observed under the inverted microscope. That is, cells protected by huangqi could continue to beat away at its normal rate. Careful observation of cells under the electron microscope after 6 days showed no virus fragments nor fiberlike inclusion bodies, and the myofibrils were intact.

In the presence of huangqi, whether it was 2, 4, or 6 days post-infection, the glycogen granules within the cell showed a marked increase. Comparison of cells in the huangqi group with those in the control group where no huangqi had been added, whether at the 2nd, 4th, or 6th day juncture after infection, showed such cell organs as cell nuclei, mitochondria, intercalary disks, myofibrils etc., to be normal, and no side effects affecting the size and shape of cells after drug use were noted. The glycogen granules also showed a marked increase (Figure 4).

Discussion

Results of electron microscope observations described above demonstrate the definitely protective action of huangqi on beating rat myocardial cells after infection by Coxsackie B-2 virus. These results and the release of myocardial enzymes lactic dehydrogenase and glutamic oxaloaceto transaminase, together with the presence of cell pulsation, cell pathological changes and other protective actions are consistent. As to the mechanism of huangqi protection, no conclusion can be made right now, as further biochemical and pharmacological experiments are needed.

According to the experiment results described in this article, before huangqi was added to the infected group on the 6th day post-infection, it was fairly easy to detect large numbers of virus particles and inclusion bodies. But it was not possible to find virus fragments and inclusion bodies in the infected group to which huangqi had been added. This explains that the chemical components of huangqi may contain certain antiviral properties or active

elements that interfere with the virus replication cycle [3]. Hou et al., reported that huangqi has an activating effect on the interferon system, and gamma interferon can be activated in the lymphocyte [4]. Experiments have proved that human lymphocyte interferon can have a protective effect on myocardial cells in virus infection [5]. After mice have been infected with Coxsackie B-2 virus, peritoneal injection of a single dose of Poly:C (interferon precursor) will exert a marked protective effect against myocarditis [6].

This experiment has demonstrated the antiviral action of the Chinese herb huangqi on cultured myocardial cells, which is similar to that afforded by interferon, though the relationship between the two is not clear. Furthermore, in cells treated by huangqi, the glycogen granules in the cell substance are more numerous than before addition of huangqi. As glycogen granules are the source of cell energy, it is possible that huangqi can step up cell metabolism to supplement its energy needs, and by that, to increase the cell's overall antiviral capacity or resistance to viruses.

As the incidence of viral myocarditis in China has seen an increase in recent years, and lacking an effective pharmaceutical approach to treating it, the results of the research experiment described above may provide definite data for clinical prevention and treatment of viral myocarditis.

The assistance of colleague Gong Zhiming [7895 1807 6900] of the Chinese Herb Pharmacy at Huashan Hospital for supplying the injection solution of the Chinese herb Astragalus membranaceus is gratefully acknowledged

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4008/1001

MICROINJECTION OF CELLS CULTURED IN VITRO

Shanghai XIBAO SHENGWUXUE ZAZHI [CHINESE JOURNAL OF CELL BIOLOGY] in Chinese
Vol 8, No 2, Jun 86 pp 89-90

[Article by Lu Ronghua [7120 2837 5478], Wu Zhijiang [0702 4160 3068], and Chen Ruiming [7115 3843 6900], all of Shanghai Institute of Cytobiology, Academia Sinica; Dai Xinlan [2071 0207 5695], Wu Lidan [0702 5439 0030], and Zhang Maogu [1728 2021 1324] participated in the experiments]

[Text] Use of micropipettes in microinjection of somatic cells was developed by Graessmann (1968) and Liacumakos et al (1970). This technique has successfully microinjected DNA, mRNA, tRNA and proteins into cells to study their biological responses [1].

At present, it is possible to take a cell cultured in vitro as a "living test tube," and through microinjection techniques introduce DNA and other macromolecules into cells to study complex biological phenomena. Because direct observation is possible, the efficiency is high. Also, directed manipulation of the injection site (cell nucleus or protoplasm) by the observer and economy in the use of hosts and receptors give this method certain advantages over red cell mediated or wax-mediated microinjection techniques.

In recent years, to further our studies in gene expression, we have devised a direct microinjection technique for cells cultured in vitro. Moreover, we used closed circuit television with a video image recording system to make a morphologic recording and television image of the microinjection process and results. This article describes this experiment in brief.

I. Microinjection Apparatus Setup

The basic pieces of microinjection apparatus are a right-handed Carl Zeiss Jena micromanipulator and an Olympic IMT type inverted phase-difference microscope mounted on a stand improvised by our institute's laboratory workshop.

II. Micropipette Preparation and Perfusion of Injection Samples

1. Preparation of Micropipettes

The micropipettes are made from glass capillaries with an inner diameter of 1 mm. The glass capillaries are cut in 7-cm sections which are then cleaned in potassium dichromic sulfate, followed by rinses with running water, then distilled water and absolute alcohol, and finally dried at 120°C. They are then stored in an airtight container until used. We used a vertical micromanipulator (produced by the Institute of Physiology) to control the micropipette used for microinjection. After adjustments are made to the various parameters -- amount of current, length of timing, and tension applied -- to be used in pulling the micropipette, a very satisfactory product can be obtained. The inner diameter of the micropipette's tip should be "honed" to 1 micron or smaller. Sometimes, the tip opening is too fine or sealed. In that case, the micropipette should be placed under a microscope and hit against a glass plate to open or expand the tip opening.

2. Perfusion of Injection Sample

We used a micromanipulator devised by us to draw in the microinjection sample through the tip of the micropipette. After the microinjection sample has been drawn up, the top of the micropipette is tilted sideways for a moment to allow small bubbles at the top to escape, and for the sample to be drawn to the top of the micropipette via the glass capillaries within the pipette. Before use, the sample solution must first be centrifuged at high speed (15,000 rpm) for 15 minutes to avoid residue particles blocking the micropipette.

III. Cell Preparation

Cells used in the experiment include human liver cancer cells of BEL-7404 system, in RPMI 1640 culture medium containing 10 percent bovine serum; NIH 3T3 in DMEM culture medium containing 10% bovine serum; and mother nerve cells NBA2 in MEM culture medium containing 10 percent bovine serum. Cells are inoculated onto bottoms of 5-cm plastic petri dishes or onto small coverslips. Usually, cells are taken for microinjection on the second day after inoculation. To locate and track microinjected cells, we used Graessmann and Graessman's (1976) method [3], where a diamond needle is used to divide the coverslip into 1-mm² small sections. Cells inoculated onto such a coverslip are easier to track and locate.

IV. Microinjection

The microinjection procedure is conducted in a sterile and regulated environment. The coverslip is placed on a 5-cm plastic petri dish containing Hank's solution or culture medium without serum, then placed under a microscope for proper focusing of the to-be-injected cell. The micromanipulator then moves the micropipette to the center of the microscopic field just so that the tip of the micropipette touches the upper end of the cell. After this, the micropipette is lowered slightly for its tip to penetrate the cell. At this time, it is possible to observe the sample solution flowing into the cell from the point of penetration to perfuse the

whole cell that it becomes noticeably larger (photos 1, 2). Once the cell has been microinjected, the micropipette should be lifted immediately, and the petri dish should be moved with the left hand for the microscope to focus on the next cell to be microinjected. This procedure is repeated again, in succession.

The micropipette is connected to a syringe through a tubing. Mediator for the liquid phase pressure conduction system within the tubing is liquid paraffin. Before injecting, the plunger for the syringe is moved forward to stabilize the pressure within the tubing. When microinjections are carried out continuously, it is not necessary then to move the plunger again. This way, once the micropipette penetrates the cell, the sample fluid will automatically be ejected. For this reason, the micropipette should not stay within the cell too long, or the cell will rupture because of an excess of sample fluid being introduced. After injections have been completed, the culture fluid should be changed, for further culture and examination of results. About 70-80 percent of the cells are still viable after injection, and continual culture also shows good results.

V. Recording and Closed-Circuit Television Imaging

The microinjection of cells is conducted under a phase-difference microscope. To make a moving recording, a closed-circuit television image recording system is attached.

The object of cell microinjection is the viable cell, and for that reason, stains cannot be used. No matter how much manipulation is being done under the phase-difference microscope, the reverse difference of the cell image is still quite low. To obtain such a microscopic image, a video recorder has to meet certain requirements -- a high degree of sensitivity, with adequate contrast. For this reason, we used a cadmium selenide camera tube, with the limited focus of the tube around 11X.

Figure 1 shows the basic schematics for the closed-circuit television system, which comprises a camera, a pre-amplifier, a video channel and a field scanner. The optical image of the cell being photographed goes through the microscope to form an image on the forked aspect of the camera tube, which emits a video signal that corresponds to the optical image. The pre-amplifier receives and converts the signal to low-noise pre-amplification. As the video signal coming from the pre-amplifier is rather grainy and coarse, it must be processed further by the video channel to form a complete video signal. Finally, the cell image appears on the fluorescent screen of the television monitor -- steady, sharp, and clear.

The experiment apparatus uses a JX-117 camera, a model 84 high-resolution monitor developed by our institute for use with highly illuminated microscopic television, and a Sony model 2630 3/4 hour video recorder. For most microscopes or phase-difference microscopes that do not have specially designed light circuits for video recording, the fork aspect of the camera tube can be placed in the microscope's light path in the spot corresponding to that for the film negative. The equipment setup is illustrated in Figure 2.

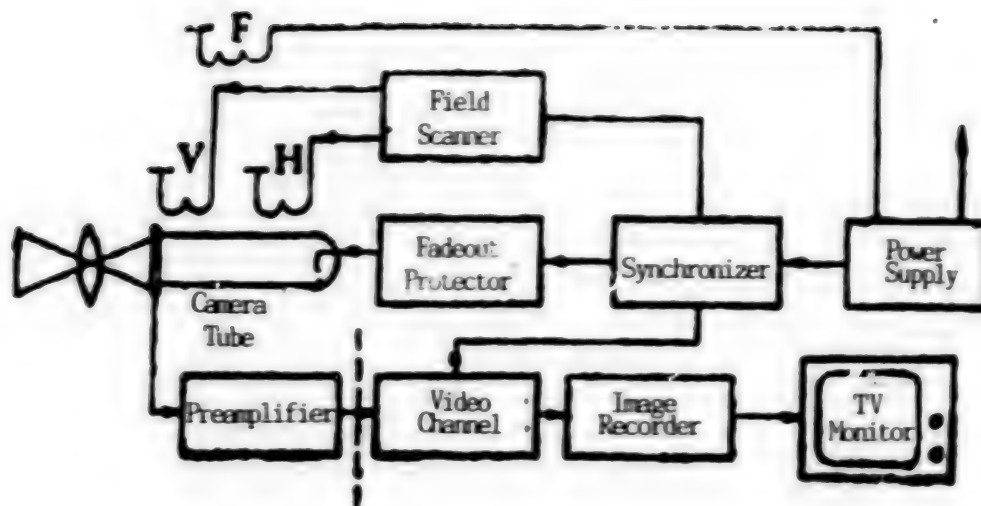


Figure 1. Basic schematics of the closed-circuit television system.

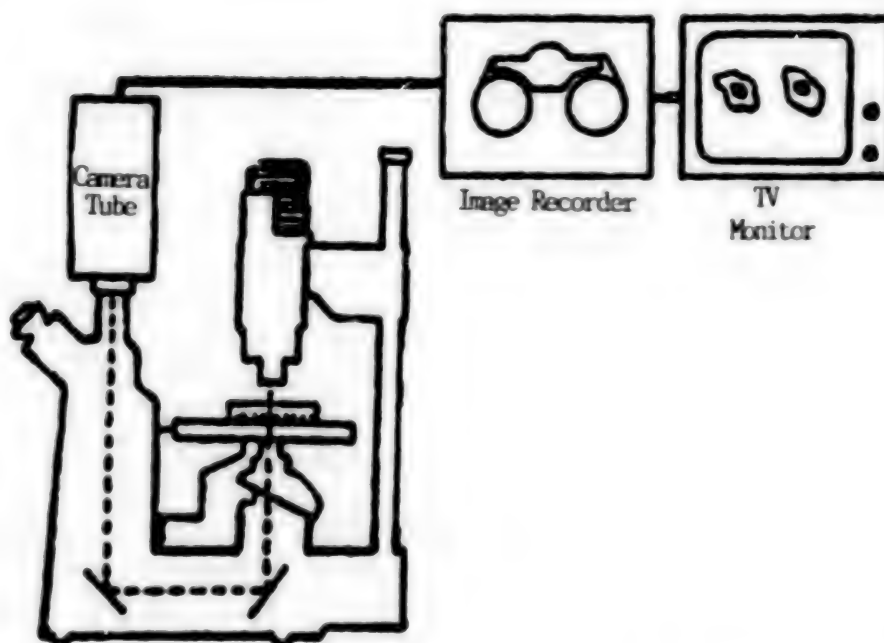


Figure 2. Setup for experiment observing and recording the microinjection of cells.

If a record of cell activity is needed, the camera can take a picture of the cell, after which the image recorder transfers the video signals onto tape. For repeated observation and detailed study, the playback mechanism of the recorder can be used. As the result of this convenient procedure, a lifelike picture of cell activity can be repeated on the screen.

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CS0: 4008/1001

SLOW LACTOSE FERMENTATION IN COLONIES OF SHIGELLA DYSENTERIAE TYPE 1

Beijing WEISHENGWUXUE TONGBAO [MICROBIOLOGY] in Chinese Vol 13, No 4, Aug 86
pp 160-161

[Article by Zhao Shangde [6392 1424 1795], Luo Shan [5012 1472], and Zhang Shunxian [1728 7311 0103], all of Yunnan Provincial Epidemiology Station, Kunming]

[Text] Bacterial colonies of *Shigella dysenteriae* type 1 usually do not ferment lactose. In 1983 and 1984, dysentery outbreaks caused chiefly by *S. dysenteriae* type 1 appeared successively in numerous localities in Yunnan Province. Isolation and assay of 60 bacterial strains from sampling of stool specimens taken from the different localities showed slow lactose fermentation in all strains. In recent years, shigellosis caused by *S. dysenteriae* type 1 has continued to occur, though the incidence of slow lactose fermentation in *S. dysenteriae* type 1 has not been reported. This paper reports on our experiences in this area.

Materials and Methodology

1. Assayed Bacterial Strains: A total of 60 bacterial strains isolated from stool samples from patients living around Chuxiong County in Yunnan Province.
2. Standard Bacterial Strains: Two strains of *S. dysenteriae* type 1 No 51121 provided by the Institute of Assay and Certification of Pharmacologicals and Biologicals, Ministry of Health.
3. Lactose Fermentation Negative Bacterial Strains: Strains of *Salmonella typhosa* and *S. flexneri* maintained at our epidemiology station.
4. Diagnostic Serum: *S. dysenteriae* type 1 serum produced by the Lanzhou Institute of Biologicals and the Chengdu Institute of Biologicals with efficacy values of 1:5120 and 1:2560, respectively.
5. Culture Media: SS agar produced by the Shanghai Sixth People's Hospital. Agar plates of Chinese blue, eosin methylene blue (EMB), and other culture media used in various biochemical tests, prepared by us following standard procedures. Analytically pure lactose, produced by the Shanghai Second Testing Agent Plant. The indicator used was Andrade's agent.

6. Testing Method: Most biochemical tests followed standard protocols, observed over a 14-day period. Four types of closure were used on the fermentation tubes: 1) ordinary cotton closure (cotton plug); 2) cotton plug with added solid paraffin seal (wax plug); 3) cotton plug placed atop liquid paraffin seal over culture medium surface (wax seal); and 4) rubber stopper. Tests were observed for 30 days at 37°C. Serological tests were done with the glass slide and test tube methods.

Results

1. Characteristics of Bacterial Colonies

Bacterial strains were gram negative, showed no spores, and no active bacilli. When inoculated onto SS agar, Chinese blue, and EMB agar plates, and cultured for 24 hours at 37°C, colonies on the SS agar plates turned red -- slightly deeper at the center, but semitransparent, neat and smooth at the margins, about 2-3 mm in diameter. Colonies growing on the Chinese blue agar plates were blue at the center, and colorless and semitransparent at the edges. Colonies growing on the EMB plates were noticeably bluish-purple without metallic luster. These characteristics became even more noticeable after culture for another 24 hours at room temperature, and showed a marked difference from those in non-lactose fermenting *S. typhosa* and *S. flexneri* 2a strains.

2. Results of Biochemical and Serological Tests

Reactions of bacterial strains to maltose, mannitol, sucrose, rhamnose, gumose, sodium malonate, phenylalanine, indigo bases, hydrogen sulfide, potassium cyanide, urea, sodium citrate, lysine, sodium acetate, mucic acid, glucosamine etc., were negative. Reactions to glucose produced acid, but no gas. Reactions to glycerol-fuchsin and M.R. tests were both positive, to V.P. test negative. Of the 60 strains tested, 5 strains were slow maltose-fermenting, and 4 strains were slow sucrose-fermenting. All the assayed strains and standard strains showed marked agglutination with *S. dysenteriae* type 1 serum on glass slides. Their test tube agglutination efficacy values were 1:1600 (with serum from Lanzhou Institute of Biologicals), and 1:800 (with serum from Chengdu Institute of Biologicals).

3. Test Results with Lactose Fermentation Tubes

Strains being assayed were placed in fermentation tubes containing 1 percent lactose, sealed with cotton plugs, and were observed for 30 days. During this time, no lactose fermentation occurred. When the lactose concentration was increased to 5%, or when the sealing method was changed, lactose fermentation was noticed. However, strains of *S. typhosa* and *S. flexneri* 2a never showed any lactose fermentation (Table 1).

Discussion

1. Except for *S. sonnei*, certain *S. boydii* type 9 forms, and individual forms of *S. dysenteriae* type 1 that can be fermenting lactose slowly, all other species in the genus do not ferment any lactose [2, 3]. In our experiment,

this lactose-fermenting characteristic in 60 strains of *S. dysenteriae* obtained from different localities in China, as shown on SS, Chinese blue, and EMB agar plates, is further confirmed by the fermentation test using 5 percent lactose. However, the reaction for this test was fairly slow, requiring 20 days usually. When the sealing method was changed and liquid paraffin was used for a tight seal, the speed of the reaction was stepped up.

Bacterial Strain	5% Lactose				1% Lactose			
	Wax Plug	Wax Seal	Cotton Plug	Rubber Stopper	Wax Plug	Wax Seal	Cotton Plug	Rubber Stopper
Assayed Strains	++	++	++	++	-	++	-	++
Standard Strains	++	+	++	+	++	+	-	++
<i>S. typhosa</i> Strains	-	-	-	-	-	-	-	-
<i>S. flexneri</i> Strains	-	-	-	-	-	-	-	-

+: fermenting lactose for 20 days; *-*: no lactose fermentation

Table 1. Results of lactose fermentation among bacterial strains tested.

2. For freshly isolated bacterial strains to cause fermentation in the test tube containing 1 percent lactose, air must be cut off, and time allowed for observation must be extended. We used liquid paraffin or a rubber stopper for a tight-fitting seal, and extended the period of observation to 30 days, or longer.

3. Slow lactose fermentation may be a basic biochemical characteristic of this serotype. For example, the bacterial strains used in this experiment were collected from different localities in sufficient numbers. Their characteristics were consistently uniform, and reactions were stable, even after several passages over the past year. Liang Xianfang [2733 6343 5364] of Guangxi Province had observed *S. dysenteriae* type 1 showing up as pink colonies on SS agar plates [4], and the standard strains in our experiment also showed up with the same characteristic. In a report by Edwards and Irwin, they had indicated that examination of all strains of this serotype were ONPG test positive [2]. The paradoxical conclusion that only some individual strains, over a long period, can ferment lactose slowly may be due to some problem in the methodology.

We believe that this characteristic of slow lactose fermentation in *S. dysenteriae* type 1 will be helpful toward better and quicker detection and diagnosis of the disease, and hope this point will be confirmed by additional experience.

Review of this article by Gu Qingwu [6581 8095 0710], director of the Institute for Assay and Certification of Pharmacologicals and Biologicals, Ministry of Health, is deeply appreciated.

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CSO: 4008/3004

SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

COUNTRY TO HOST INTERNATIONAL CHEMISTRY CONFERENCE IN JULY

OW151640 Beijing XINHUA in English 1514 GMT 15 Mar 87

[Text] Nanjing, 15 Mar (XINHUA)—China will host the 25th International Conference on Coordination Chemistry in Nanjing next July, announced Dai Anbang, chairman of the conference.

Dai, honorary director of the Research Institute on Coordination Chemistry of Nanjing University, told XINHUA here today that preparation is under way smoothly.

"Coordination chemistry is a frontier science relating to theoretical, organic, biological, catalytical chemistries and environmental science and other sciences, which have had a wide application in society," Dai said.

The previous 24 conferences were hosted by 22 countries and China is the fourth one in Asia to host the conference, Dai said.

"We Chinese chemists feel honored to be entitled to host the conference," Dai said, adding that the State Council and various departments have offered their assistance.

So far, 1,140 chemists and scholars from 59 countries and regions have said they will attend the conference. Among them are U.S. Professor H. Taube, the Nobel Prize winner in chemistry, noted U.S. Professor J.C. Bailar, Japanese Professor K. Santo, chairman of the International Union of Pure and Applied Chemistry and E. Volpin, professor from the Soviet Union, according to the chairman.

Also about 500 Chinese chemists and scholars have handed in application forms, Dai added.

The host will offer services to help the conference delegates enjoy local folk performances and tour other Chinese cities, said Dai.

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CSO: 4010/1015

SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

SHANGHAI MOLECULAR BIOLOGY LABORATORY OPENS

OW171840 Beijing XINHUA in English 1711 GMT 17 Dec 86

[Text] Shanghai, 17 Dec (XINHUA)--The Shanghai Molecular Biology Laboratory will open to scientists at home and abroad at the beginning of next year [1987], an official of the Chinese Academy of Sciences said here today.

Set up by the Shanghai Biological Chemistry Institute, the lab will help in the study of international molecular biology. The lab is equipped to look into complicated scientific subjects such as the structure and function of biological molecules, molecular genetics and biomembrane, he said.

The lab is the first of 20 major labs which were planned to be built during the 1980-1985 period. The construction of the other 19 will be completed by the end of this year and the beginning of next year, said an official of the State Planning Commission.

The commission official said, 50 major labs will be built in the 1986-1990 period, with their research fields including biological technology, micro-electron studies, information science, chemistry, physics, geology, agriculture sciences and medical sciences.

Those labs, mainly used for basic science study, will also open and become the centers for academic activities, he said.

"Visiting scholars will help with study projects at the new lab and also use it for their own study subjects. They'll be invited to work in the lab for 2 to 3 years," he said.

The Shanghai Biological Chemistry Research Institute, a leading institute in China, boasts a number of well-trained scientists and has achieved many scientific successes such as the synthesing of insulin.

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CS0: 4010/1015

SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

ANTIBIOTICS EXPERT ZHANG WEISHEN PROFILED

Beijing YAOXUE TONGBAO [CHINESE PHARMACEUTICAL BULLETIN] in Chinese Vol 21, No 6, 8 Jun 86 pp 363-364

[Article by Cai Niansheng [5591 1628 3932], Institute of Antibiotics, Chinese Academy of Medical Sciences]

[Text] Professor Zhang Weishen [1728 3634 3947], a native of Wuxian in Jiangsu Province, was born in June 1909. He graduated from Qinghua University with a degree in chemistry, after which he taught as assistant professor and lecturer at the university. In April 1946, he went to the United States and attended the University of Wisconsin to pursue graduate studies in biochemistry. After obtaining his doctorate degree there, he continued as a research associate until he returned to China in April 1951. Since then, he has assumed positions as professor in the agricultural chemistry department of Xibei Agricultural College at Wugong, Shenxi Province, chief technologist at the Central Biological Products Research Institute in Beijing, deputy chief of the antibiotics department at the Central Institute of Experimental Hygiene, first level research associate, and served on the committee of the Chinese Pharmacopoeia. In October 1958, when the Institute of Antibiotics of the Chinese Academy of Sciences was established, Professor Zhang became its director, a position he held until his death in August 1966. In 1954, he joined the Jiu-San Society, and served on the committee of its Beijing branch. In June 1956, he joined the Chinese Communist Party.

Professor Zhang is a scientist well known in the fields of microbiology, biochemistry, and antibiotics. He was earning a good salary in the United States, and his wife was already in Hongkong, prepared to join him there, when he heard that the Chinese mainland had been liberated. Being fiercely patriotic, he made up his mind then to return to China. The U.S. invasion of Korea in the fall of 1950 further aroused his feelings of national self respect and hastened his return, though the immigration authorities had wanted him to stay.

At the time of his return, he did not bring back much, except for some colorless strains of penicillin that he was working on. He figured that antibiotics research in China at that time was a void, and there was an urgency for antibiotics research and production to meet the needs of China's great population. Even though he had the strains of antibiotics, the primary

raw materials such as lactose and corn mash needed for production were lacking in China. Professor Zhang faced reality and initiated research into substitute raw materials. He was able to successfully substitute corn mash with cottonseed meal cakes that are ordinarily used for fertilizer in the Chinese countryside, and lactose with corn meal. Not only did he resolve the raw material problem, he also lowered capital expenditures substantially. Following this, he personally led a group of technical personnel to work at the Third Pharmaceutical Plant of Shanghai to conduct intermediate expansion of fermentation units which were improved after repeated trials. For this outstanding contribution to the industrial production of penicillin in China, Professor Zhang was cited as Beijing's model worker in 1953, and was received by Chairman Mao, a very exciting experience which made him work even harder. Recognizing this outstanding achievement, international scholars in the field also recognized and rated Professor Zhang highly, and he was invited to report on his work at an international scientific conference in Warsaw in 1956, and at the All-Soviet Conference on Antibiotics in 1957. At the same time, he also displayed the spirit of internationalism and warmly welcomed colleagues from Korea who have come to China to study, and helped them to quickly master the technique of penicillin production, so they could begin actual production upon their return home. Later on, Professor Zhang led a research group to further study catabolic processes related to the synthesis of penicillin and terramycin. He continued simultaneously with the experimental production of terramycin, erythromycin, and streptomycin. As the result, he provided important data for the industrial production of these antibiotics.

To plan and build up the Institute of Antibiotics at the Chinese Academy of Medical Sciences, Professor Zhang searched for the best talent, and brought in a team of solidly qualified specialists. Given the resources that were available then, a fairly scientifically adequate and solidly based institute was completed in 1958. After the institute was built, selection and screening studies were actively instituted for many new antibiotics under Professor Zhang's direct leadership. During a short space of a few years, production strains for aspergillin, vancomycin, griseofulvin, paramomycin, kanamycin, and polymyxin were screened and selected. At the same time, Professor Zhang paid a great deal of attention to the coordination of theory and reality, and emphasized development work while strengthening procedures on antibiotic intermediate trials with techniques. This approach promoted the successful experimental production of these new products, which quickly led to industrial production, and to filling some of the void in antibiotic production in China.

Professor Zhang was also very interested in international developments and research in this field. When semisynthesized penicillin research first appeared in certain advanced countries, he had already foreseen the future development of these new products. He initiated research on the penicillin mother nucleus 6-APA, and led colleagues to start research on semisynthesized penicillin. By creating something new, this group synthesized a new penicillin, conducted screening and selection trials, and established a foundation for synthesized and semisynthesized antibiotics research.

During the 1950's and the 1960's, China was already paying much attention to antibiotics work, and the State Committee on Science had established an antibiotics branch. Minister Qian Zhongxin [6929 1813 0207] of the Ministry

of Health headed the Special Studies Section, with Shen Qizhen [3088 0366 7201], deputy of the Chinese Academy of Medical Sciences as the deputy section chief, and Professor Zhang as the the deputy executive officer to oversee the work. He was very concerned with the development of antibiotics work in China. During the early period of antibiotics research, he personally conducted antibiotics workshops and classes, and compiled a volume of lectures on the topic. After this, he was directly involved in calling the second and third All-China conferences on antibiotics. He presented a scholarly paper entitled "The Present and Future Status of Antibiotics" at one of these meetings. After both meetings, he also compiled and published the proceedings, which greatly stimulated research into antibiotics in China. He made a definite contribution by initiating research studies into antibiotic quality control, and by conducting yearly conferences for exchange of experiences and research program planning to resolve quality control problems such as allergic reactions and pain often encountered in penicillin and streptomycin use.

Professor Zhang had great love for China and supported the Communist Party's leadership. In praising Professor Zhang, Minister Qian Zhongxin said: "He always conducted his affairs in accordance with the Party's directives. He maintained an air of simplicity and diligence in his scientific work, and adhered firmly to economy in the estimate and use of research expense, permitting no waste nor action that worked against the economic system. Dedicated to public service, Professor Zhang lived a simple life. He always tried to economize on his trips, whether at home or abroad, preferring to ride his bicycle whenever possible, rather than be chauffeured in an automobile, to attend meetings. He lived at the institute, and always made the rounds of the laboratory and the medium-sized trial units upon rising in the morning and late at night before retiring.

"Professor Zhang was very concerned about the growth and development of young cadres. His approach called first for routine nurturing, then instruction according to available resources and individual abilities, capped by equal treatment and concern for all. In guiding his research workers, he was open about sharing his knowledge, but he paid greater emphasis to developing their independent thinking and creativity. He always taught his young colleagues to be single-minded in pursuing their scientific research, even to the extent of being totally immersed, to accomplish their goals. He was similarly friendly with the common workers, concerned about their work and their livelihoods. He was considered a very approachable person. Not only was he one of the founders of the antibiotics industry in China, he was also the good friend and teacher of the scientific worker and bosom ally of the common worker."

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SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

BRIEFS

SHANGHAI OCEANOGRAPHIC RESEARCH CENTER--Shanghai, 7 Feb (XINHUA)--China's first research center to study the ocean's waves and storms was set up here today. The center is designed to facilitate development of the country's marine production, ocean transport and offshore petroleum resources. XINHUA also learned that Shanghai marine meteorologist Qian [words indistinct] was appointed a member of an ad hoc group of climatologists specializing in numerical wave modelling and working under the world meteorological organization. The group has six other members representing Norway, the United States, Great Britain, the Federal Republic of Germany, France and the Soviet Union. [Text]
[Beijing XINHUA in English 1430 GMT 7 Feb 87] /8309

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